



**U.S. Department
of Transportation**

**Intelligent Transportation Systems
Professional Capacity Building Program:**

***ITS Training & Education Needs Assessment Baseline:
A Review and Synthesis of Thirteen Prior Studies, Field
Interviews, and A Summary Assessment of ITS Needs***

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Executive Summary

Synopsis

Successful deployment, operation, and management of Intelligent Transportation Systems (ITS) requires a new breed of transportation professionals, according to research, extensive outreach, and information gathered to date. The U.S. DOT has responded by developing ITS training courses, and establishing the Professional Capacity Building (PCB) Program in 1996 to help prepare transportation professionals for the new millennium. Over 100 course offerings have been presented to over 3000 professionals as of December 31, 1997.

This three-part report documents the PCB needs of current transportation professionals in the context of ITS Metropolitan Infrastructure deployment. It is based on 1) a synthesis of thirteen prior ITS education and training needs assessments; 2) supplemental field interviews with ITS practitioners, and 3) a summary assessment of PCB needs. **The findings indicate a critical need to move ahead aggressively in development and delivery of education and training at all levels to meet ITS deployment goals and objectives. While present programs provide good initial ITS training, more advanced courses are needed, many more professionals must have access to courses, and alternative approaches to learning that are grounded in the use of new information/communications technologies must be adopted.**

Meeting these critical needs requires a major new commitment from a wide array of DOT organizations. Specifically, the PCB effort itself should place immediate priority on these next steps:

- Develop a more complete understanding of the full range of ITS skills and training needs.
- Identify gaps between critical knowledge, skills, and abilities (KSAs) and current training so appropriate new courses can be initiated.
- Establish a process to develop new offerings and update existing courses.
- Explore new media options that can increase PCB cost-effectiveness and accessibility.

The success of these steps is predicated on the DOT surface transportation agencies, particularly FHWA and FTA, joining in an effort to build a new breed of transportation professionals within their ranks, and within their agency counterparts at state, regional, and local levels.

This report's suggested course of action flows from research findings that indicate:

- Existing courses and those already planned are on target for recognized PCB needs; though more advanced courses targeted to meet specific audiences' needs must be developed.
- PCB needs vary from region to region and from agency to agency within regions.
- Highway-related needs have been explored, to date, more thoroughly than transit-related needs.
- Job-specific learning objectives and curriculum course sequences have yet to be determined.
- Implementing agencies are not well prepared to pursue widespread ITS deployment
- Lack of travel funding, travel restrictions, busy staff, and staff turnover hinder the delivery and effectiveness of PCB training using traditional methods.

Next Steps - Short Term Priorities

Prior training and education needs assessments provide a good foundation for a more comprehensive focused assessment of ITS/PCB needs and associated program directions. In addition to a more complete treatment of ITS needs in the metropolitan deployment context, rural ITS and commercial vehicle needs must also be addressed, as very little research has been done on these topics. Although an assessment of commercial vehicle training needs is underway currently, the focus of this assessment is to determine whether current courses address current needs of the commercial vehicle transportation professionals audience. Eventually, a broader range of needs, both present and future, will need to be developed. The Rural program is still to be addressed.

The following provides more detail on suggested next steps and the research findings that support this next course of action. Key next steps include:

- 1) **Develop a more complete understanding of the full range of ITS skills and training needs.** Additional research is necessary to compensate for insufficient specificity in the definition of needed skills, underrepresentation of agencies and modes in prior studies (specifically, transit), and lack of curriculum sets and course sequences for typical professions. The result of this research should provide: detailed learning objectives for course development; indications for training priorities and curriculum sequences; and an overall framework that relates PCB needs to ITS deployment objectives and corresponding agency roles and staff positions.
- 2) **Identify the gaps between critical skills and existing training courses.** Courses currently exist that address both general and specific ITS subjects. These courses need to be evaluated to determine the extent to which they adequately cover PCB needs. Remaining needs — those not covered in existing courses — need to be translated into new training requirements. Priority criteria for developing new training should be set according to deployment criticality.
- 3) **Establish a dynamic process to refresh and update existing courses, and initiate new offerings.** Periodic consultation with planning and implementing agencies is essential to ensure that offerings address current Federal, State and local needs across modal agency boundaries. Most transportation professionals are not in a position to know what they need to know until they need to know it.
- 4) **Explore new media options that can increase PCB cost-effectiveness and accessibility.** Evolving program policies and technologies call for rapid development of new training courses, as well as timely updates of existing courseware for on-demand delivery to thousands of transportation professionals scattered throughout the nation. To overcome limitations on travel and instructor resources, distance learning techniques using multi-media CD-ROM and/or live presentations transmitted over video communications links should be assessed to determine how to use such technologies constructively.

The above-listed immediate priorities provide the primary focus for the PCB program in the near-term. The program's longer-term steps must focus on mainstreaming ITS training and education. Mainstreaming efforts will be directed at existing training programs within

transportation agencies, professional associations, the private sector, and educational programs — from outreach to younger students to technical training at junior, community and trade colleges, to undergraduate and graduate degree programs at colleges and universities.

These near-term and longer-term next steps for the PCB program were developed in light of findings that resulted from the program's initial assessment of needs. This preliminary effort was undertaken to develop a baseline of information of what is already known about ITS needs of transportation professionals. The critical overall baseline findings and specific findings of each report are presented below.

Overall Findings

- 1) **Existing developed courses and those already planned are on target for recognized PCB needs at a general level.** The initial suite of PCB courses (covering planning, public/private partnerships, transit, telecommunications, National ITS Architecture, and procurement topics) introduces subject areas of obvious and immediate importance in the context of metropolitan ITS infrastructure deployment. However, it is clear that **this initial series needs to be reinforced with more advanced materials.** Professionals that have graduated from learning about why it's important to consider ITS and what it takes to plan, fund, deploy, and operate ITS applications, are ready to move on to learning how to deploy ITS prudently.
- 2) **PCB needs vary from region to region, and from agency to agency within regions depending on prior ITS exposure and experience.** In areas with little prior exposure, agencies need an awareness of ITS, its benefits, and the vision of ITS deployment and operations as a cooperative partnership. In areas interested in pursuing deployment, agency interests grow to encompass planning, architecture, standards, specifications, and procurement. In areas with regional deployment underway, agency needs expand to include contract management, and preparing for ITS operations and maintenance once the contractors are gone. Due to rapidly evolving technology and institutional innovations, most agencies see an unprecedented need for ongoing professional development beyond that needed to enable and facilitate initial deployment.
- 3) **Highway-related needs have been explored more thoroughly than transit-related PCB needs.** Advanced Traffic Management Systems (ATMS) and traffic engineering professionals have received the most extensive consideration, while needs related to Advanced Public Transportation Systems (APTS) and transit system operators have received far less attention. Similarly, implementation and operations needs have been studied more than planning and maintenance needs. ITS training needs relative to technical topics have been examined more than non-technical issues. Little differentiation of PCB needs by staff level (e.g., executive, management, technician) has occurred, and to date, PCB courses have been developed for a general audience with technical backgrounds.
- 4) **Job-specific learning objectives and curriculum course sequences have yet to be determined.** Identifying training and education needs for ITS professionals is a first step. Learning objectives and core course sequences need to be structured to guide the professional development of transportation planning and implementing agency staff.

- 5) **Implementing agencies are not well prepared to pursue widespread ITS deployment and need greater ITS awareness and understanding, as well as the requisite capabilities for deployment.** Even agencies that have achieved more advanced levels of ITS deployment typically have a very small cadre of professionals who are capable of sustaining ITS development and operations. To differing levels, professionals in most implementing agencies still need:
- an awareness of the emerging importance of ITS in surface transportation,
 - a compelling appreciation of ITS benefits and how these can be realized,
 - a clear understanding of their role in ITS planning, deployment and operations, and
 - the requisite skills to overcome unfamiliar technical challenges and institutional impediments so as to effectively plan, deploy, and utilize ITS alternatives with the same ease and certainty of well-entrenched, conventional practices.
- 6) **Lack of travel funding, travel restrictions, busy staff, and staff turnover hinder the delivery and effectiveness of PCB.** The lack of funding to attend training, out of state / area travel restrictions, and competing staff time demands hinder access to PCB opportunities. Cost-effective new delivery media, such as computer-based training and distance learning techniques, need to be utilized to reach professionals in a manner more convenient to their schedules and that overcomes restrictions. The availability of new information and communications technologies provides the opportunity to structure the delivery of materials and learning in new and innovative ways.

These findings and next steps are based largely on the review of thirteen prior needs studies and supplemental field interviews conducted in 1997. They are also consistent with commissioned white papers on professional society / association perspectives (documented in a companion publication), feedback from PCB training course participants, and interim findings from an FHWA agency-wide training needs assessment.

Specific Report Findings

Findings from the Synthesis and Review of Thirteen Prior Studies report

This report synthesizes the conclusions of thirteen prior studies that reviewed ITS needs in three areas: (1) the need for additional staffing for ITS and whether labor would be available (referred to as Staffing Studies), (2) the need for additional training that is required with the application of ITS (referred to as Training Studies), and (3) training and educational needs that are required by ITS (referred to as Staffing and Training Needs Assessments). All of the reports found that **ITS requires introducing new knowledge, skills, and abilities (KSAs) into the transportation profession and that full deployment of ITS will require new staff and retraining of existing staff.**

The studies identify some staffing issues, skills and training needs, some sources of training, barriers to training, and concerns about the ability of organizations to staff for full deployment. Critical issues that were identified are:

- Current availability of technical staff is insufficient to support full deployment of ITS.
- There is a lack of personnel with required scientific and technical skills to support ITS in the transportation labor market.
- A strategy is needed to ensure that elected officials and senior management support training over the long-term.
- Training must be developed that addresses the different skills that are required throughout an organization and for the different functions (such as technical, institutional, administrative, etc.) that support deployment.
- Resources need to be made available to allow agencies to provide on-the-job training to ITS staff.
- ITS needs *were* identified in these studies; however, the level of specificity was such that it is not possible to translate the identified needs into training. For example, one ITS need that was frequently mentioned throughout the studies is the need for computer training. It was not identified who needed the training, at what level, or on what aspect of the computer (e.g., hardware, software, databases, use of algorithms, or simply how to use a mouse).
- An overall analysis of the studies reveals some limitations. The studies are usually either too general — providing a simple catalog of general skills required of ITS deployment, or too specific — addressing one facet of ITS, one specific organization’s needs, a limited geographic area, or staff at a narrow organizational level. Many studies have been done by agencies and organizations interested in traffic engineering, resulting in an emphasis in that profession’s training needs. **This leaves a gap in knowledge about ITS staffing and training needs of other transportation professions and organizations. For example, only a few of the studies include information from transit agencies and focal governments.**

The next steps toward a comprehensive assessment of ITS staffing and training needs will build on the information summarized in this report regarding what was learned from the studies about training and staffing needs and about the knowledge gaps found in analyzing these studies.

Findings from the *Field Interviews* report

This report presents the conclusions from a series of field interviews that were initiated to supplement the findings from the *Review and Synthesis of Thirteen Prior Studies* report. Discussions were held with personnel from the U.S. DOT FHWA and FTA (Headquarters, Regional and Division levels), State DOTs, transit agencies, and city DOTs. **In general, Federal, State and local respondents agreed on the need for training as well as some specific training areas** detailed below.

Technical:

- Communications hardware technology: fiber and wireless, switches, routers and video equipment
- System engineering and architecture for public agencies
- Traffic management software, data and analysis
- Maintenance of systems after warranties expire

Institutional:

- Interacting with other agencies
 - “What’s in it for me” -- ITS advocacy training:
 - How to get staff to use ITS technology?
 - How to get stakeholders to buy into ITS?

Contractual:

- Writing specifications
- Understanding the software development process
- Managing contract workers

Lack of training was emphasized to be impeding deployment. It was agreed that courses offered through the ITS PCB program will help implement deployment. Other training will be needed to fill in the gaps identified through the field interviews.

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**Intelligent Transportation Systems
Professional Capacity Building Program:**

**Section I —
A Review and Synthesis of Thirteen Prior
Studies**

Preface

Intelligent Transportation Systems (ITS) are designed to enhance the safety and efficiency of surface transportation systems by implementing advanced electronic sensors, navigation devices, communications, and information technologies. The General Accounting Office cited “a lack of technical knowledge and expertise among the state and local officials who will deploy the systems” as a significant obstacle confronting widespread ITS deployment.

The ITS Professional Capacity Building Program (PCB) was established to ensure that current transportation professionals have the knowledge, skills, and abilities to effectively deploy ITS. The program has adopted a multi-faceted approach to identify gaps in the knowledge, skills and abilities that serve as impediments to ITS deployment. The overall approach draws upon the review and synthesis of prior ITS training needs studies; interviews with Federal, state, and local ITS field staff; white papers on professional society / association perspectives; and commentary from PCB course participants. In addition, PCB needs assessment is closely coordinated with a comprehensive, agency-wide training needs assessment effort now being conducted by FHWA.

This report, ITS Professional Capacity Building: A Review and Synthesis of Thirteen Studies, serves as a companion report to ITS Professional Capacity Building: Field Interviews. This report summarizes what other organizations concerned about ITS staffing and training have learned and identifies knowledge gaps that need to be addressed. The Field Interview Report identifies the staffing and training needs of agencies and organizations actively involved in deploying ITS. The information in these studies provides a representational, rather than a scientific, sampling of ITS staffing and training issues. Combined, these studies provide a basis for targeting training courses and curricula to address ITS professional capacity building needs.

1 Urban Transportation: Challenges to Widespread Deployment of Intelligent Transportation Systems (Letter Report, 02/27/97, GAO/RCED-97-74).

I. Introduction

Full national deployment of Intelligent Transportation Systems (ITS) requires development of staff with the knowledge, skills, and abilities (KSAs) to plan, design, build, operate, and manage ITS projects. Developing this staff requires training. A starting point for identifying ITS staffing and training needs is the ITS deployment sequence:

- **General Awareness of ITS** that establishes the foundation for understanding the need for ITS the scope of ITS, and the roles of agencies involved in ITS deployment;
- **Planning for ITS** which encompasses the notion of establishing a regional framework and develops an understanding of conformance to the National Architecture;
- **Designing for ITS** with an eye towards interoperability and intermodalism;
- **Procuring for ITS** including innovative procurement and financing methods;
- **Installing ITS** which includes the role of contracting organizations; and
- **Operating and Managing** the ITS system once deployed.

Analysis of ITS training and staffing studies published since 1992 provide a starting point for identifying current and future ITS staffing and training needs. These can be roughly categorized as Staffing Studies, Training Studies, and Staffing and Training Needs Assessments. These studies, which for the most part identify issues raised by individuals and organizations involved in some aspect of ITS deployment, provide important information about the staffing and training concerns of these agencies. The thirteen studies reviewed for this report are summarized individually in three appendices.

This report provides a synthesis of these studies and identifies work that still needs to be done. While none of the studies use the deployment sequence as a model, the sequence is still a useful tool for summarizing and analyzing their information. The studies are also limited because most were developed with a limited focus and lack the specificity needed to develop a training and education program. In addition, the needs assessment approaches used in these studies were either too general or not comprehensive enough to address the core training needs of ITS deployment.

This report contains four sections:

- The first section categorizes and broadly summarizes the studies reviewed and the approaches authors used to gather and analyze information.
- The second section summarizes the overall findings on staffing and training. It provides a synthesis of the skills and training identified as needed in the studies reviewed in addition to a summary of other issues affecting staffing and training. This second section places these findings into the structure defined by the ITS deployment sequence.
- The third section identifies the current gaps in knowledge. Three major areas of shortcomings have been identified, which include identification of core knowledge, skills, and abilities; development of curricula, courses, and programs; and delivery of courses and programs with educationally effective media.
- The fourth section proposes a general framework for a comprehensive ITS staffing and training needs assessment.

The report concludes with general recommendations for addressing transportation professionals' ITS needs over the next five years, including a continuing effort to gather information for a more comprehensive ITS needs assessment.

II. Summary of Existing Studies

Studies completed to date fall into three broad categories: Staffing Studies, Training Studies, and Staffing and Training Needs Assessments. Staffing Studies identify current and future staffing needs either for national deployment of ITS or to address ITS issues within a specific agency or profession. Training Studies identify skills needed to address ITS issues and the type of training required to transfer these skills to current or new staff. Training and Staffing Needs Assessments either define an approach to identifying staffing needs, training needs, and sources of training, or specifically analyze these three factors. Studies are grouped below.

Staffing Studies

- Institute of Transportation Engineers (ITE), *White Papers: Operating and Maintaining Advance Traffic Management Systems (ATMS) Centers*, 1996.
- Kraft, Walter H., *Conference Summary and Conclusions, IKE National Conference on Operating and Maintaining ATMS Centers*, 1996.
- McComb, Dwight E. and Martin J. Monahan, *Federal Highway Administration ITS Field Technical Expertise: Workshop Summary Report*, 1994.
- Robinson, Carlton C., *Traffic Operations Manpower: A Scoping Study of Education Needs and Responses*, 1994.
- Urban Institute, *IVHS Staffing and Education Needs*, 1993.

Training Studies

- California Advanced Transportation Training Alliance, *The View Ahead*, 1996.
- ITE, *Urban Traffic Engineering Issues and Answers: Urban Traffic Engineering Education and Training Needs, Final Report*, Undated.
- ITS America and U.S. DOT, FHWA, *ITS Education and Training; Strategic Planning Workshop Proceedings*, 1995.
- ITS America and U.S. DOT, FHWA, *Strategic Plan for ITS Education and Training (Draft)*, 1996.
- U.S. DOT, Office of Traffic Management and ITS Training Team, *DOT ITS Professional Capacity Building Assessment*, 1995.

Staffing; and Training Needs Assessments

- Corridor Coalition, *Project II Training and Technology Exchange Final Report*, 1996.
- SAIC/JHK, *Technical Memorandum on ITS Training Needs*, 1996.
- Virginia Tech, *Virginia Tech Model for Professional Capacity Building: Comprehensive Needs Analysis & Functional Specialization*, Undated. (NB: This study suggests a method for completing a comprehensive staffing and training needs assessment.)

II.A Overview of Studies Reviewed

Developing a training strategy requires an understanding of KSAs required at each stage of a process and at each level of participation in the process. For ITS, this requires understanding training needs along the deployment process and through organizations, from senior management, to maintenance and support staff. A first step in needs assessment is therefore a literature review of past ITS training studies.

Studies done to date have either gathered general information across a broad range of transportation professionals or specific information from a narrow range of professionals. Several studies sponsored by the Federal Highway Administration (FHWA) and other agencies have had broad mandates to identify ITS staffing and training needs. For example, a study done by the Urban Institute (*Urban Institute Study*) for the FHWA analyzed the labor market to determine whether individuals with training and skills would be available to develop, implement, and operate ITS. Several other studies that were also broad in nature were undertaken to identify potential skills that ITS deployment may require. This was typically done by asking transportation professionals, academics, and others to list all the skills they thought were important for ITS.

Most studies looked at training needs narrowly. For example, one report looked at the training needs of traffic engineers who may have ITS responsibilities. Another looked at the needs of a staff in a single organization with limited ITS responsibilities. Both the broad and narrow studies provide information that is useful to begin the process of identifying ITS training needs. Despite these limitations, some studies have taken a first step towards matching skills with specific training. A study sponsored by the I-95 Coalition reviewed courses currently available that may be applicable to ITS. In addition, several studies considered methods of training, including formal degree programs, in-service workshops, on the job training, and self directed training.

II.B Methods Used to Identify Needs

The studies relied on several different methods to collect information on ITS staffing and training needs. They frequently included a review of other studies on the same and related topics. Additional information was been gathered through several methods including surveys of individuals and organizations that have, or may have, an interest in some facet of ITS.

Some surveys were done formally; others were less formal, simply asking interested parties to summarize skills they considered important for ITS. The range of surveys used and organizations surveyed vary. One overall problem with the surveys was that they were directed to a very limited population, such as staff from a specific agency or individuals that perform specific ITS related functions. Additional methods of gathering information included interviews, focus groups, workshop, and other supplemental information.

Two studies are important for both their approach and their findings. *The first is the Urban Institute Study*, published in 1993. This was the first study to review the labor market for personnel with skills likely to be required for ITS — then called Intelligent Vehicle Highway Systems (IVHS). This information was refined through interviews and surveys of organizations involved in ITS. It also considers training available in ITS related skills. This study is referenced in most of the other studies reviewed.

The second study is the I-95 Study completed in 1996. It reports information from staff actively involved in ITS activities along the I-95 corridor and from training organizations. It provides an analysis of the demand for training and supply of training resources. The approach taken by this study is a comprehensive assessment of ITS training needs based on results from a survey of transportation agencies along the I-95 corridor.. This study builds on other research, but is unique because many organizations responding to the survey are actively involved in deploying ITS.

The Urban Institute and I-95 studies are useful bookends because information provided in the *Urban Institute Study* was developed for the first time, and the I-95 Study provides the most comprehensive model for an analysis of ITS training needs. Other studies conducted in the time between these two studies started with surveys and discussions centered on whether existing training meets the needs of ITS and how training can be adapted to incorporate skills required for ITS. These studies looked at specific aspects of ITS or specific organizations involved in ITS. The result was a focus on more immediate needs rather than identifying the long-term range of skills and training ITS will require.

II.C Synthesis of Findings

There is general agreement that ITS requires bringing new knowledge, skills, and abilities (KSAs) into the transportation profession and that full deployment will require retraining existing staff as well as adding new staff. Prior studies have identified some staffing issues, skills, and training needs. They also identified sources of training, barriers to training, and concerns about the ability of organizations to staff for full deployment.

Key findings fall into three major areas: general findings, staffing findings, and training findings. The major general finding is that full ITS implementation requires addressing three major issues: awareness, education, and training. There is also general agreement that identifying who needs training first requires identifying the organizations that will be responsible for deploying ITS so that the level and type of training needed can be determined. Once training needs are established, it is possible to analyze existing resources that may be used to develop training courses. The last step is to identify specifically the knowledge, skills, and abilities that staff involved in ITS require.

This section summarizes what has been learned from these studies about requisite skills needed for ITS, training needed for ITS deployment, and other issues related to ITS staffing and training. It has four parts. The first part summarizes key *staffing* findings, these being the most important things learned about how staffing is directly related to ITS needs. The second part summarizes major training findings, these being the most important things learned that directly relate to identifying skills and training needs. The third part identifies training needs by intensity level by synthesizing information from the studies. The last part identifies other issues that will affect ITS training and staffing.

II.C.1 Staffing Issues

Major staffing issues identified in the studies reviewed are:

- **Current availability of technical staff is insufficient to support full deployment of ITS.**
- **A comprehensive, continuous, long-term training program can address this staffing need.**
- **A strategy is needed to ensure that elected officials and senior management support training over the long-term.**

Staffing issues include availability of individuals with required training and the ability to train current and future staff. Studies also identified staffing issues not specifically relevant to training activities including issues related to salary, benefits, culture, and career tracks in agencies that are most likely to be involved in ITS. A significant issue may be the ability of agencies to hire staff. The positions required for ITS may not currently exist, which would require developing new position descriptions

and adding staff. Many government agencies have established reducing staff as a goal and may be a major issue in agencies considering ITS deployment.

The Urban Institute Study highlights this concern by noting staffing constraints faced by government agencies. They broaden this concern to include comments on the availability of government staff to do nontechnical functions such as institutional, economic, social, and environmental. An additional concern is the availability and training of operations and maintenance personnel in support given these functions. The *Urban Institute Study* found a lack of personnel with required scientific and technical skills in the transportation labor market. However, it suggests that this need could be met by retraining personnel from the defense sector.

Several studies note that ITS skills are learned on-the-job. For example, most traffic control center personnel learn how to do their job after a brief period of in-house training. This is necessary because each center is unique and requires specific on-the-job training. A concern expressed in several studies was the availability of trained staff to provide this type of training.

Studies note that the current level of knowledge, while sufficient to support current ITS activities, is not sufficient for future activities. Nationwide deployment of ITS will create a demand for more technical staff than is currently available; therefore, training and retraining are necessary to have sufficient staff for full deployment of ITS. Several studies note that training in non-technical skills is as important as training in technical areas.

A long-term staffing issue identified in several studies is support for training. Agency staff are concerned that elected officials and senior managers will not provide long-term support to a training program. One report recommends developing a strategy to show importance of ITS staff training to senior management and elected officials. This strategy should make the point that training should be available through a continuous education program.

II.C.2 Training Issues

Major training needs identified in the studies are:

- **Training needs that address skills needed at different staff levels within organizations and for different functions along the deployment sequence should be developed.**
- **The models for training identified in studies should be considered when developing new courses and curricula.**
- **Resources need to be made available to allow agencies to continue to provide on-the-job training to ITS staff.**

Training issues identified in prior studies provide a guide for identifying specific training needs and developing delivery approaches. Studies found that staff from different organizations and at different levels have different needs. This requires looking at each ITS skill in terms of who is responsible for what at which organizational level and sequence.

The survey results reported in the I-95 Study categorize training in relation to six major functional categories: Planning, Design, Construction, Operations, Maintenance, and Management. These

categories can be associated with the ITS deployment sequence, and provide a starting point for this analysis. The study also surveyed organizations that are potential training resources. The responses by those requiring staff training and those available to provide training establishes a starting point for evaluating training demand and supply.

Several studies were directed at specific specialties within the transportation profession. For example, one study recommends development of new media for education and training in traffic engineering. Another recommends development of a core curriculum from the proposed Traffic Operation Core Curriculum and require courses funded through NHI grants be patterned after this curriculum. Studies also identify staffing, funding, operational, and other issues related to all aspects of operating a Transportation Management Center (TMC) and the need for implementation of a traffic engineering certification program.

Other studies target specific organizations. One study recommends that training be developed to enhance ITS knowledge of FHWA and FTA field staff. Another identifies the FHWA as a source of high level technical expertise in ITS. This study suggests that FHWA develop an in-house inventory of technical expertise and support enhancement of State DOT technical expertise. One study suggests that DOT investigate development of an ITS Education and Training Institute. Yet another study recommends that the federal government continue to support Technology Transfer Centers, University Transportation Centers, and Research Centers of Excellence, and coordinate ITS activities with these organizations and professional and industry organizations.

Studies found that agencies are looking at how they currently provide training and what improvements can be made. Agencies implementing an advanced traffic management system, for example, use on-the-job training by experienced staff to train new staff. A concern is that, once ITS is fully deployed, staff resources may not be sufficient to continue to provide on the job training.

ITS will bring staff from different organizations together to address transportation issues. It will also bring people with different skills together. A method to maximize both staff capabilities and training is to cross train staff involved in traffic management center deployments.

Overall the studies report that agencies are aware of some, but not all, existing training resources. Several studies have catalogued sources of training, but no critical analysis of this training has been done. Potential users of training programs note that time and budget constrain agencies from providing training, as do institutional issues.

II.C.3 Training Needs by Function and Level

Major training needs by component, enabling technologies, institutional issues, and functional areas identified in the studies are:

- **Linked to specific ITS components: APTS, ATIS, ATMS, CVO**
- **Linked to specific enabling technologies: communications, computers, and other**
- **Linked to institutional issues: awareness, funding, safety and security, and other**
- **Linked to functional areas: planning, design and construction, operations and management**

Studies identified training needs, often linked to specific ITS components, the specific needs of an agency or a region, or a combination of both. The following tables summarize what was learned about training needs and identifies some gaps in this knowledge. The tables provide information about the level of interest in training for different ITS components and skills across six functional areas. These tables use the I-95 study as a model for synthesizing this information. (The I-95 study is summarized in Appendix C.)

The information provided in the following tables is representative of ITS training and staffing needs, but is not based on a scientific analysis of these needs. The first table groups skills by ITS component the second by enabling technologies, and the third by institutional issues. The final three tables identify skills needed for ITS planning, design and construction, and operations and management. For an ITS function or skills to appear on a table, it must have been identified in at least one of the thirteen studies. A description of how the tables are designed follows.

Column 1 Level of Interest

Several studies report survey information on the level of interest in training in ITS skills. This can be inferred from other studies by noting how often training in a skill is identified in reports. The key to this column is:

- H High level of interest in training in this skill.
- M Moderate level of interest in training in this skill.
- L Low level of interest in training in this skill.
- NR No Response. This is reported when the information was provided by a survey and survey respondents did not respond to questions about the skill.

Column 2 Table Title

The second column of every table provides the title of the table and, in five of the six tables, two levels of information. The first level categorizes a general ITS component or skill, such as APTS or Computers. The second level identifies specific skills, such as Transit Vehicle Tracking or Hardware. Planning, Table 4, provides information on components and skills under the category of planning.

Columns 3 to 8 Planning, Design, Construction, Operations, and Management

The I-95 Study serves as a model for the information summarized in the following tables. That study defined ITS skills by specific functions, these functions being Planning, Design, Construction, Operations, and Maintenance. The authors of the I-95 study surveyed transportation professionals, educators, and others to identify the level of interest in training in different ITS skills and in the six functions. This is useful because these functions closely follow the ITS deployment sequence followed by the accompanying Volpe Center study on ITS training needs. U.S.

An X in a box indicates that one or more reports have specifically identified a need for training in a specific skill to address a specific function. For example, referring to Table 1, ITS Components, APTS Multimodal coordination. Each function is marked with an X, indicating that one or more studies reported a need for training in this skill at each function.

A blank box usually indicates that information in reports is not sufficient to determine training needs in the functional area. Referring again to Table 1 - ITS Components. Under APTS, Transit vehicle

tracking, all of the functions are blank. This indicates that more information is needed to determine what training, if any, is needed in these functions for this skill.

Table 1 - ITS Components

Table 1, on the next page, summarizes information from several reports on training needs related to component systems that would be part of an integrated ITS deployment. Several reports identify these specific component systems as defining the staffing and training needs of agencies and organizations deploying ITS.

Table 1 - ITS Components

Level of Interest	ITS Component	Planning	Design	Construction	Operations	Maintenance	Management
M	Multi-modal coordination	X	X	X	X		X
L	Transit vehicle tracking						
H	Route guidance	X	X		X	X	X
H	Variable Message Signs (VMS)	X	X	X	X	X	X
M	Broadcast-based	X	X		X	X	X
M	Kiosks	X	X	X	X	X	
M	Traveller advisory telephone	X	X		X	X	
L	In-vehicle				X		
NR	Highway Advisory Radio (HAR)						
H	Incident detection & verification	X	X	X	X	X	X
H	Incident Response	X	X	X	X	X	X
H	Probe Technologies						X
H	Violation enforcement systems	X	X	X	X	X	X
M	ATMS Control Center Operation						
M	AVL/AVI	X			X	X	X
M	CCTV	X	X	X	X	X	X
M	Freeway Control	X	X	X	X	X	X
M	HOV Lane Control	X	X	X	X	X	X
M	Incident Management						
M	Ramp metering				X	X	X
M	Sensor Technologies	X	X	X	X	X	X
M	System Optimal Routing	X	X	X	X	X	X
M	Traffic Control & Surveillance						
M	Traffic Signal Control				X	X	X
M	Video Imaging Processing	X	X	X	X	X	X
L	Control Center Operations						
L	Electronic Toll and Traffic Management (ETTM)						
L	Transportation Management Center	X					
H	Electronic clearance		X		X	X	
H	HAZMAT management	X		X	X	X	X
H	Weigh-in-motion	X	X	X	X	X	
M	Roadside CVO safety		X	X	X	X	
L	Fleet administration						
L	Freight administration						

Note that two ITS components, Rural ITS and Advanced Vehicle Control and Safety Systems (AVCS), do not appear on Table 1. Information on these components is not provided on any of the tables because no report provided sufficient information to make any assessment of training needs in these ITS components. Of the components where some information is provided, the least information is provided about Advanced Public Transportation Systems (APTS). Only two components of an APTS system are identified. Very few studies have gathered information from public transit agencies. A significant amount of information is provided about the other three component systems. More is known about these systems because some of these systems have been deployed and because several studies specifically examined these component systems.

Table 2 - Enabling Technologies

The following table, Table 2, summarizes information from several reports about enabling technologies that will be required for ITS deployment. Information provided about these technologies covers a broad range of staffing and training needs. For example, some studies identify the need for computer training, without defining whether there is a need for hardware or software training, for specialized training in specific computer systems, or whether staff will require a general understanding of computers. Some of these gaps are filled by other studies.

Table 2 - Enabling Technologies

Level of Interest	Enabling Technologies	Planning	Design	Construction	Operations	Maintenance	Management
H	Communications						
H	NTCIP	X	X		X	X	X
H	Wire	X	X	X	X	X	X
H	Wireless	X	X	X	X	X	X
M	IEN	X			X	X	X
H	Hardware	X	X	X	X	X	X
H	Software	X	X	X	X	X	X
M	Component Selection						
M	Computer Systems/ADP/Software/Hardware						
M	Traffic Modeling Software						
L	Computer Selection						
L	Navigation						

Table 3 - Institutional Issues

Table 3 summarizes information from several reports that identify training needed to address a variety of issues that have been combined under the title Institutional Issues. These range from ITS awareness and marketing to training needed to address legal and procurement issues unique to ITS. Some of these skills have multiple facets. For example, legal issues range from those related to contracting with partners to develop the system to liability issues that may arise after a system is fully deployed.

Table 3 - Institutional Issues

Level of Interest	Institutional Issues	Planning	Design	Construction	Operations	Maintenance	Management
H	Marketing/Market Evaluation						
H	Overview	X					
M	Awareness	X	X	X	X	X	X
M	Technologies for different levels of personnel	X	X	X	X	X	X
M	User Services						
L	Information Dissemination Techniques						
L	ITS Overall/Integrated Training						
L	ITS Technical Issues						
L	ITS Technologies						
L	Success and Benefits						
L	Traveler Information						
L	User Acceptance						
M	Funding/Financing						
L	Federal Aid Process						
M	Safety						
L	Security						
H	Legal Issues (Partnerships Liability, etc.)						
M	Procurement		X				

The next three tables address training needs that roughly correspond to the deployment sequence summarized in the Introduction.

Table 4 - Planning

Table 4 summarizes information from several studies about training needs to address the ITS planning function. Planning for ITS has several facets. Some are oriented to design and construction, others to integrating the ITS planning process into the larger transportation planning process. Note that this table differs from other tables in this section. Planning serves as both the table title and as a general ITS skill. What follows are specific skills within the planning category.

Table 4 - Planning

Level of Interest		Planning	Design	Construction	Operations	Maintenance	Management
	Planning						
H	Contracts and Procurement						
H	Institutional Issues	X			X		X
H	Planning (Process for ITS)						
M	Benefits/Costs	X			X		X
M	Costs and staffing requirements					X	X
M	Demand Management Strategies						
M	Evaluation						
M	Integration of ITS in the planning process	X					
M	ITS Benefits	X					X
M	ITS Costs		X				
M	ITS Deployment Planning	X			X		X
M	Partnering						
M	Research & Development						
L	International Issues						
L	ITS Overall/Integrated Planning						
L	Needs Determination						
L	Risk Management						

Table 5 - Design & Construction

Table 5 combines information from several reports about training needed for the ITS design and construction functions. Several reports noted that, while individuals with these skills are available, they do not generally work in the transportation field. One of the challenges that needs to be addressed for full deployment of ITS is how to attract people with these skills to transportation organizations and how to train existing transportation professionals in these skills. This has been characterized as training traffic engineers in systems engineering and systems engineers in traffic engineering.

Table 5 - Design & Construction

Level of Interest	Design & Construction					Planning	Design	Construction	Operations	Maintenance	Management
M	Acceptance/Inspection							X			X
M	Construction/Inspection/Practices										
H	Systems Architecture										
M	Integrating ITS into facility design						X				
M	Plan reviews and specification development						X				
M	Specifications										
M	Standards										
M	Systems Engineering										
L	Systems Design										
L	Systems Integration										
L	Electrical Engineering										
L	Human Factors										

Table 6 - Operations & Management

Table 6 summarizes information from several reports identifying Operation and Management training needs. The effectiveness of ITS will be demonstrated by how well the system works. This will create unique demands on managers at all levels and will require staff with specialized operational skills. Reports also note that managers and operators will need considerable flexibility to address the range of responsibilities required for ITS deployment. Several studies recommend cross-training staff at the operations and management level to address this need.

Table 6 - Operations & Management

Level of Interest		Planning	Design	Construction	Operations	Maintenance	Management
	Operations & Management						
H	Operations & Maintenance						
M	Operations & Maintenance Costs					X	
NR	Managing ITS projects						
NR	Inspection Procedures for ITS Equipment						
M	Traffic Flow Theory						
L	Traffic Engineering						
M	Technical Training				X		
M	Technician Training				X		
M	Train the Trainer/How to Train						
L	Operator Training						

II.C.4 Other Issues

In summary, other major issues are:

- **Training will require dedication of long-term resources.**
- **Delivery mechanisms should be targeted to address needs of organizations requiring training.**
- **Staffing must address institutional issues as well as training issues.**

Identifying training needs cannot be limited to specific skills where training is required but must consider other issues, including how training is delivered and institutional barriers. A concern identified in many of the reports is that sufficient resources may not be available for future training. One report notes that training is a low priority in many organizations and likens securing resources for training to the difficulty of securing sufficient resources to operate and maintain existing infrastructure. These issues fall into two broad categories, training delivery and institutional barriers to staffing and training.

While agencies are aware of several sources of training, they are not aware of all sources. The preferred providers and methods of training are those that have historically been used by the transportation profession. These include National Highway Institute (NHI) and National Transit Institute (NTI) courses, colleges, conferences/workshops, seminars, and equipment vendors. Time and budget concerns are identified as a barrier to training, one which can be somewhat addressed by providing training through one-day seminars, short courses, in-house training, videos, simulations, and table-top exercises.

ITS deployment will require attracting people from outside traditional transportation disciplines into the transportation sector. One study found that the major problem in meeting staffing requirements will be in economic, social, and environmental areas, operation and maintenance, and not in technical areas. Institutional issues affecting staffing in training are usually outside of the control of agencies involved in ITS. State and local governments, for example, either have specific policies designed to reduce total staffing or regularly address budget issues through freezes on hiring staff or contracting work. In addition, many transportation organizations only have career tracks for civil and traffic engineers, but not for other professionals.

II.D Knowledge Gaps

The studies done to date provide a starting point for identifying ITS skills, training needs, delivery methods, and training sources. They also provide some insights into the training and staffing concerns of organizations that will deploy ITS. This information provides a solid starting point for a comprehensive analysis of ITS staffing and training needs across the deployment sequence and through organizations and responsibilities. That analysis will then provide a basis to evaluate existing training, develop new courses and curricula, and create a standard by which future training needs can be assessed.

The previous chapter offered a synthesis of what was learned from the thirteen studies conducted to date and identified issues raised from this review. The analysis of these studies revealed gaps in the existing foundation of knowledge about building professional ITS capacity.

Specifically, gaps exist in the following areas:

- **State of the knowledge about core knowledge, skills, and abilities required for ITS deployment and operation.**
- **State of specificity for developing curricula, courses, and programs for ITS training, education, and outreach activities.**
- **State of the knowledge of course delivery and delivery mechanisms.**

Most of the studies surveyed only the first issue, and often in general terms. For example, it is not unusual to see computer training identified as a need created by ITS. Studies provide no additional information to determine whether this training is required due to an overall lack of computer expertise in an organization or due to some specific aspect of ITS that will require specific types of computer skills. This lack of specificity makes development of training difficult.

Several studies identify specific training needs and approaches to training for ITS. Synthesizing the information from these studies results in identifying some skills and functions requiring ITS training. More importantly, it results in identifying what we do not know, or isn't known in sufficient detail, about ITS staffing and training needs.

The Urban Institute Study identifies some skills required for ITS deployment. Studies done by the FHWA and the I-95 Coalition add to this list of skills. The I-95 Coalition study goes a step further by relating skills to ITS functions as well as identifying training currently available.

A comprehensive needs assessment will take this work a step further by linking skills to deployment stages and training needs. Such an assessment will also evaluate available training against the need to identify courses and provide a foundation for creating curricula, courses, and training for specific skills. A comprehensive assessment would also identify how to deliver and evaluate training. The next part of this chapter describes a framework for identifying core knowledge, skills and abilities, which provides a starting point for a comprehensive needs assessment.

II. D. I Identifying Core Knowledge Skills and Abilities

Identifying core knowledge, skills and abilities requires:

- **using the deployment sequence to structure this analysis.**
- **evaluating knowledge, skills and abilities needed at each stage of the deployment sequence**
- **identifying future skills that will be required for ITS deployment and operation**

The first step in relating skills and training needs to the deployment is to identify the deployment sequence. While ITS is rarely deployed in a linear fashion, identification of a deployment sequence allows for a targeted identification of knowledge, skills, and abilities needed at specific times. Organizations and job categories can then be attached to this sequence to identify who needs these skills when.

In general, the ITS deployment sequence includes:

- **General Awareness** of ITS that establishes the foundation for understanding the need for ITS, the scope of ITS, and the roles of the agencies involved in ITS deployment;
- **Planning for ITS** which encompasses the notion of establishing a regional framework and develops an understanding of conformance to the National Architecture;
- **Designing for ITS** with an eye towards interoperability and intermodalism;
- **Procuring for ITS** including innovative financing methods;
- **Installing ITS** which includes the role of contracting organizations; and
- **Operating and Managing** the ITS system once deployed.

The deployment sequence provides a structure for identifying core skills and associated training needs. Unfortunately, none of the studies completed to date have systematically related knowledge, skills, abilities and training needs to ITS deployment. Most studies have started with either a general understanding that ITS will require some technical skills, such as computers or communications. Other studies took a know-n component of ITS, such as a Traffic Control Center, and considered the training needs to operate and maintain that center.

Some skills are needed across the ITS deployment sequence, while others are specific to a deployment stage. A comprehensive needs assessment would identify the training needs for skills required at each stage of deployment.

Most of the studies reviewed considered whether enough is known about ITS to identify future skills required and training needs. A few studies looked at specific types of jobs, such as those in a traffic control center, to better understand the skills required to do what is currently being done. This then becomes a starting point for more discussion of how something being done today will change because of increased attention and resources going toward ITS. The result of these studies is less a detailed understanding of skills for ITS than a discussion of the skills and training needed to accomplish specific tasks in specific organizations.

II.D.2 Developing Curricula, Courses, and Training

Development of courses, curricula, and training requires:

- **Ranking training needs.**
- **Evaluating existing training in ITS related skills.**
- **Having the flexibility to address changes in ITS training needs.**

Most studies do not provide enough specificity to develop comprehensive courses and outreach materials. Developing this training requires understanding overlaps and linkages between job categories with ITS responsibilities throughout various agencies. Training needs also must be ranked to ensure that development of training meets the need for training. A starting point for developing curricula, courses, and training is existing training in areas related to ITS, but analysis of this training should U.S. be done.

Specificity is important when developing a training program to ensure that the training addresses staffing needs. This begins by getting a better understanding of skills needed for ITS deployment. Many studies identify these needs so broadly that meaningful training cannot be developed. For example, developing training based on an identified need for people with computer skills is quite difficult when little additional information is available about what kind of computer skills are needed.

Understanding overlaps and linkages is necessary because many ITS technologies are applicable to multiple modes of surface transportation and across geographic areas. This provides the opportunity to develop courses that cover information useful to many agencies and ITS functions. Recognizing these linkages and overlaps can help in providing training that is intermodal and integrated. It also allows for efficient use of limited training resources.

Training needs will change over time, which requires establishing priorities for training based on current and future needs. Some studies attempt to rank training needs, but it has been done in a very general way driven by a current need of a specific organization. Developing a national program requires looking across all stages of ITS deployment and implementation of ITS and identifying present and future training needs.

Several studies looked at available courses to address ITS training needs. This analysis was, for the most part, superficial. For example, one study recognized a need for training in Advanced Vehicle Identification (AVI)/Advanced Vehicle Location (AVL) and identified a course for this training. The course, however, does not provide the training needed for ITS. A close examination of the course found that the course is an overview of vehicle positioning and navigation for land, marine, and air systems. It also does not address AVI/AVL highway and transit operations at a depth that would be useful to operators of such a system.

The proceedings from *the ITS Education and Training: Strategic Planning Workshop* report that the most people need general training. Specialized training should include a broad spectrum of participants in the transportation research, education, planning, construction, operation, maintenance, management, and policymaking process. Other studies support this conclusion.

Most of the studies assume that transportation personnel will be trained in aspects of ITS, including those necessary for the operation of ITS but not specifically transportation skills. Training people with skills such as communications and computers to understand basic transportation issues and issues related to ITS also will be necessary. This is important to note because the Urban Institute found that sufficient staffing for ITS requires attracting people from outside the transportation profession for ITS work.

II.0.3 Delivering Training

Delivering training requires:

- **Assessing how training will be delivered is as important as developing courses and curricula.**
- **There are constraints to receiving training, including time, costs, and distance.**
- **Training delivery methods which can address constraints, including development of training videos and provision of on-site training.**

Various and disparate ITS courses and training programs are in existence. These programs often treat ITS as an exotic afterthought rather than as an integral part of the surface transportation system. Any training program must also address practical obstacles to learning, be well publicized, and include a mechanism for evaluating the effectiveness of various training approaches.

Some studies identify courses that may address some ITS training needs. The largest compilation is reported in the I-95 Coalition study. A review of these courses found that, for the most part, the courses were developed to address a specific need at a specific location. For example, one state conducted a skills assessment and recognized a need for training operators in advanced traffic signal control systems. The impetus for this effort was an economic development initiative. In other efforts, professional associations and the federal government have developed courses on various aspects of ITS implementation and some universities are developing ITS courses as part of their graduate transportation engineering programs.

Some ITS courses are autonomous seminars that address specific issues related to ITS without putting ITS into the larger context of an integrated transportation system. Training programs that treat ITS as an afterthought or as an exotic approach to addressing transportation issues. This approach is not compatible with the goal of fully integrating ITS into an intermodal and multimodal transportation system.

III. A Framework for a Comprehensive ITS Needs Assessment

The major ITS training issues described at the beginning of this report highlight the need for a thorough and comprehensive assessment of ITS training needs. The studies done to date provide an important foundation on which to build a method for assessing training needs. However, they do not provide sufficient information to develop a comprehensive approach to ITS training.

The first step in a comprehensive needs assessment is to work within the ITS deployment sequence and identify the training required at each stage. The deployment sequence has been identified. The next step will be to identify skills and training needs at each of these stages. The deployment sequence presented in Section III begins this process. **The second step in developing a comprehensive needs assessment will be to identify training needs at the executive, management, practitioner, and technician levels of organizations that will be involved in ITS deployment. A valuable source of information will be individuals currently involved at some level of ITS deployment, which could range from planning to full scale operation.**

Information gathered in this second step would include how individual jobs/functions relate to ITS, how personnel holding those positions obtained skills, and identification of other skills needed to do the job. Other information that would be collected from practitioners would be identification of skills that are most critical and immediate, changes needed in the job/function to support ITS deployment, and anticipated future training. The positions themselves would be identified along the ITS deployment stage sequence to identify where and when skills are needed.

The I-95 Corridor Coalition Final Report may be a model for a comprehensive assessment of ITS training needs. This study provides a good understanding of skills required and training needs for those staff with ITS-related responsibilities along that corridor. It also identifies the most comprehensive catalog of ITS-related training currently available. The study did not look at ITS training needs through all of the organizations potentially involved with ITS along the I-95 corridor, nor does it look across each organization to assess training needs.

Given limited resources to analyze training needs and to develop training, the development of a comprehensive needs assessment will require setting priorities. ITS is being implemented at various levels of intensity in different parts of the country. Areas are also at different stages in the ITS deployment sequence. Where areas are now, in both level of intensity and stage in the deployment sequence, provide a starting point for collecting information on staffing and training needs across organizations, at different levels within organizations, and across the deployment sequence.

Collecting information at selected areas at various stages of ITS deployment will provide an objective understanding of who is involved in ITS, what skills they bring to their jobs, and what skills are needed to continue to support their work. Collecting this information from areas at different stages of ITS deployment would provide some insight into the skills needed along the deployment stage sequence. This also will help in setting priorities for development and delivery of training. **Given that the studies done to date do not provide a comprehensive assessment of ITS training needs, and given the priority ITS has been given on both a national and local level, it is important that this comprehensive assessment gets done.**

IV. Summary and Conclusion

This analysis and summary of thirteen studies provides a starting point for a comprehensive assessment of ITS staffing and training needs. Information from the studies reviewed for this report provides some useful information for developing some ITS courses and curricula. *The Field Interview Report* will provide additional information for this work.

The thirteen studies provide some information on current ITS staffing and training needs and some sources of training. These studies also identify issues related to the delivery and support of training within institutions deploying, or considering deploying ITS. The studies also identify gaps in knowledge. **A major gap is identifying what skills are needed across the ITS deployment sequence and at all levels of responsibility within organizations responsible for ITS deployment.** This information provides the basis for the next steps toward a comprehensive assessment of ITS staffing and training needs, which will define the professional capacity building program over the next five years.

The next steps include a systematic ranking of training priorities, identification of skills and training needs to organizational levels, and gathering information to fill identified knowledge gaps. A comprehensive assessment of ITS staffing and training needs will address these key needs.

This assessment will lead to:

- **understanding the full scope of ITS knowledge, skills, and abilities;**
- **understanding skills needed at each point in the ITS deployment sequence; and,**
- **understanding skills required by ITS organizations at each organizational level.**

This information can then be synthesized to identify staffing and training needs. This synthesis becomes the basis for evaluating existing training courses and developing new courses and curricula. This will result in the provision of training and the development of the skilled workforce needed for full ITS deployment.

V. Appendix A - Staffing Studies

Report/Paper:	Institute of Transportation Engineers (ITE). <i>White Papers: Operating and Maintaining Advance Traffic Management Systems (ATMS) Centers, Prepared for the National Conference on Operating and Maintaining ATMS Centers</i> , September 14 and 15, 1996, Minneapolis, MN.
Method:	Review of literature. White papers on specific aspects of operating and maintaining ATMS Centers. Workshop discussions.
Key Finding(s):	Cross train staff within organization and through visits to other centers. Training should be an on-going process. Supplement classroom training with simulated events or tabletop exercises.
Training Needs:	Refer to training needs identified in I-95 Study including communications and computers specifically related to operations and maintenance of new systems like Advanced Vehicle Location (AVL), Computer Aided Dispatch (CAD), and Automated Traffic Counting Systems (ATCS), and systems engineering.
Other Issues:	Increased use of ATMS elements expected. Minimum operation and maintenance standards essential to improving agency operations and maintenance abilities. Improved operations and maintenance of Freeway ATMS (FATMS) will require additional resources including funding, staff, and training. ISTEA will increase FATMS activities.
Conclusion:	Review of literature and identification of issues related to training staff to operate and maintain traffic management systems centers. Two white papers--one on staffing, the other on training--identify significant concerns about availability of training and staff for these centers.

- Report/Paper:** Kraft, Walter H. *Conference Summary and Conclusions, ITE National Conference on Operating and Maintaining ATMS Centers*, Minneapolis, MN; September 14 & 15, 1996.
- Method:** Synthesis of information collected at Minneapolis, MN workshop.
- Key Finding(s):** Made recommendations regarding administration, operation, funding, staffing, National Transportation Information Communications Protocol (NTCIP) standards, training, liability, and computer systems issues related to Transportation Management Centers. The key recommendation regarding staffing and training is that sufficient qualified, well-trained and cross-trained staff need to be provided to both operate TMC systems and maintain TMC software/hardware.
- Training Needs:** Training recommendations include:
Cross-training within agencies,
Include training requirements on operating and maintaining technology in contract specifications,
Training coordinators should develop and update training matrices for agency classifications,
Visits to other TMCs should be part of training,
Training should be provided to staff outside of the TMC to provide additional staff when needed,
Training should include simulations and tabletop exercises,
Use of expert resources from other industries,
Establish and maintain database of operation and maintenance contacts and training programs,
ITE should work with educational institutions to develop and update curricula to reflect training needs of TMC staff.
Agencies should identify a training coordinator, and
Agencies operating TMC should work with stakeholder organizations to include applicable training in their programs.
- Other Issues:** Identify staffing, funding, operational, and other issues related to all aspects of operating a TMC.
- Conclusion:** Summarizes information gathered at a workshop on operating and maintaining Advanced Traffic Management Systems (ATMS). Identifies priorities of traffic engineers with responsibilities related to ATMS. Focus is on needs of traffic engineering staff involved with TMCs.

- Report/Paper:** McComb, Dwight E. and Martin J. Monahan. *Federal Highway Administration ITS Field Technical Expertise: Workshop Summary Report*, Chicago, IL, December, 1994.
- Method:** Information collected at workshop of FHWA personnel. Draft version reviewed by FHWA staff and comments were incorporated into this report.
- Key Finding(s):** Technical expertise is important in the ITS program. The FHWA has a major role in providing technical expertise. The workshop identified 80 specific needs to enhance FHWA field staff stewardship of ITS programs. These fall into three types of technical expertise: program and project management; basic technical concepts and application; and detailed design.
- Training Needs:** Gain and maintain better working knowledge of technical issues through a database that addresses technical transfer issues, courses and workshops on core technical issues, development and dissemination of state of the art product and project information, and identify critical items from use in staff analysis of ITS projects.
- Other Issues:** FHWA should also provide access to high level technical expertise, develop guidelines for PS&E reviews and field inspections, contract support, develop an in-house inventory of technical expertise, and support enhancement of State DOT technical expertise.
- Conclusion:** Identifies roles and responsibilities and prioritize the technical expertise needed by of FHWA staff who have ITS responsibilities.

- Report/Paper:** Robinson, Carlton C. *Traffic Operations Manpower: A Scoping Study of Education Needs and Response*. Prepared for the National Highway Institute, FHWA, October 15, 1994.
- Method:** Interviews with professional leaders and review of literature and programs. Two day meeting with 12 senior level professionals representing employers of entry-level traffic operations personnel. Meeting with professionals representing transportation and educational organizations.
- Key Finding(s):** Public agencies that hire individuals in the professional traffic operation field require 550 new entrants annually. Emerging needs of ITS may create a need for an additional 300-500 annual entrants.
- Training Needs:** Recommend a core curricula for professional entrants in the traffic operations field.
- Other Issues:** Program outlined, while not equivalent to a masters degree program, would equip entry level candidates for traffic operations jobs with the base of knowledge needed to undertake entry level duties.
- Conclusion:** Study identifies knowledge areas required of traffic operations professionals serving state and local government. Begins to define a modular education and training program to build knowledge areas for potential candidates to do this work. This was designed to establish priorities for the NHI and others involved in training.

- Report/Paper:** Urban Institute, *IVHS Staffing and Education Needs*, Prepared for the U.S. DOT, Federal Highway Administration (FHWA), September, 1993.
- Method:** The purpose of the study was to identify labor market availability of staff for full deployment of IVHS. Used data from several sources as input to model which projected both demand for and supply of IVHS labor. Conducted interviews and surveys of potential employers of IVHS staff
- Key Finding(s):** Labor market can meet demand for trained technical staff, but only if opportunities provided for skilled professionals from fields that are reducing employment opportunities. Specifically identified the defense industry as a source of staff with required technical skills.
- Training Needs:** Retraining of professional and technical personnel within and outside of the transportation field.
Need for training to develop leadership, facilitator, coordination, political, and program management skills.
Multi-disciplinary training required, including electronics, telecommunications, traffic engineering, human factors, and software engineering.
Specific training needed to increase personnel with skills in maintenance and operation of traffic signal systems, deploy, operate, and maintain automated traffic controls, and develop and manage databases.
All aspects of implementing ITS in rural areas.
- Other Issues:** Problems meeting staffing requirements will not be in technical areas but in economic, social, and environmental areas and operation and maintenance.
Wage caps, hiring ceilings and other institutional constraints will cause bottlenecks in staffing.
Training method will differ with skills being taught and audience receiving training.
- Conclusion:** Analysis of the labor market to determine whether adequate staff will be available for full implementation of ITS.

V.I. Appendix B - Training Studies

- Report/Paper:** California Advanced Transportation Training Alliance. *The View Ahead*, Prepared for the Project California Select Panel Meeting, March 22, 1996 (Revised).
- Method:** Cite Project California report identifying application of advanced technology to transportation issues as a promising area for economic development. Interviewed firms involved in advanced transportation industry, found that these firms have had problems obtaining qualified employees.
- Key Finding(s):** Identified four occupations requiring immediate training, these are:
Project manager/traffic systems
Automatic traffic signal system technicians
Electric vehicle mechanic (not ITS)
Geographic information system specialist.
- Training Needed:** Subjects related to above occupations.
- Other Issues:** Need to develop organization to identify and analyze occupations in advanced transportation industry, analyze technology, industry structure, and location, pinpoint training needs, develop curriculum to meet demand for new skills and arrange for training.
- Conclusion:** Funding proposal. Plan to do needs assessment once funding secured.

- Report/Paper:** Institute of Transportation Engineers (ITE). *Urban Traffic Engineering Issues and Answers: Urban Traffic Engineering Education and Training Needs, Final Report*, Undated.
- Method:** Literature review.
Surveyed traffic engineering agencies.
Focus group meetings.
Project committee discussions.
- Key Finding(s):** Traffic engineering staff training areas include both technical and non-technical subjects.
Graduates prepared in traditional civil engineering areas, but not in traffic or non-technical areas.
Need for continuous education.
On-the-job, on-site and remote training most effective.
Time and budget constrain training.
Agencies use short courses for traditional traffic engineering subjects, also require training in new subjects like ITS and TDM.
Lack of awareness about training resources.
- Training Needed:** Non-technical subjects like technical writing, communications, and administration.
Awareness of ITS and other advanced traffic insuring subjects/
Traffic Demand Management (TDM).
Implementation, operation, and maintenance of traffic control systems including, but not limited to, ITS.
- Other Issues:** Develop core curriculum from the proposed Traffic Operation Core Curriculum, require that courses funded through NHI grants be patterned after this curriculum.
Develop media for education and training in traffic engineering.
Implement traffic engineering certification program.
Support of Technology Transfer Centers and Urban Transportation Centers and coordinate activities with these organizations and professional and industry organizations.
Increase awareness of existing resources.
Sensitivity to cost, time, and location issues when developing training.
- Conclusion:** Report on training and staffing needs associated with traffic engineering.
Focus narrower than ITS but is specific to an ITS function.

- Report/Paper:** ITS America and U.S. DOT, FHWA. *ITS Education and Training; Strategic Planning Workshop Proceedings*, Sheraton Reston Hotel, Reston, VA, June 12-14, 1995.
- Method:** Presentations designed as starting point for workshop participants consideration of ITS education and training needs.
Discussion guidelines.
Workshop breakout sessions considered education and training demand and supply issues for different levels of training providers and specific types of organizations requiring training.
- Key Finding(s):** ITS staff need training in variety of technical and non-technical subjects.
Supply side sessions identify sources of training.
One page synthesis provided of demand and supply side sessions.
- Training Needs:** ITS providers, transportation decision makers, educators, students, and transportation Users need education and training in ITS awareness, technology, economics, and institutions.
Specific knowledge is required in:
 Computer Science.
 Economics.
 Human Factors.
 Communication technologies.
 Information systems.
 Systems analysis/engineering.
 Government structure and institutional arrangements.
 Finance, procurement, and developing partnerships.
- Other Issues:** ITS training needs should be addressed as early as elementary school.
Formal programs for ITS staffing should begin in Junior College.
Existing sources of training should be used to deliver training.
Different responsibilities require different knowledge at each stage of the deployment process.
- Conclusion:** Papers presented to workshop participants and reports from workshops that considered ITS training from both the demand and supply sides.
Participants in workshops included academics, state and federal officials, consultants and industry representatives, and students.

- Report/Paper:** ITS America and U.S. DOT, FHWA. *Strategic Plan for ITS Education and Training (Draft)*, Developed from the ITS Education and Training Workshop, June 12- 14, 1995, Reston, VA, July, 1996.
- Method:** Draft summary of Reston workshop proceedings.
- Key Finding(s):** Workshop identified three essential components required to successfully implement ITS initiatives: awareness, education, and training.
- Training Needs:**
- Awareness
 - ITS Technologies
 - Partnerships
 - Systems engineering
 - Procurement
 - ITS costs and benefits
- Other Issues:**
- Increase staff and financial resources to support ITS-related student activities.
 - Develop and disseminate educational materials.
 - Help colleges and universities identify funding for curriculum development and other educational activities.
 - Investigate development of ITS Education and Training Institute.
 - Enhance knowledge of FHWA and FTA field staff.
 - Identify the feasibility of creating an ITS America Education and Training Excellence Award.
- Conclusion:** Restates major issues identified in workshop proceedings. Focus narrowed.

- Report/Paper:** United States Department of Transportation (U.S. DOT), Office of Traffic Management and ITS Training Team. *U.S. DOT ITS Professional Capacity Building Assessment*, May 24, 1995.
- Method:** In house assessment by task force of U.S. DOT staff to develop a federal perspective and plan for addressing ITS education and capacity building issues. Categorized training into three types; awareness, overview, and skills and knowledge training. Identified personnel requiring each category of training including DOT staff, other federal staff, elected officials, state and local staff, academics and students, the private transportation sector (consultants, operators), and ITS users (drivers, transit riders, etc.).
- Key Finding(s):** All transportation personnel require awareness training. Federal, state, and local technical personnel should be provided overview training. Skills and knowledge training should be provided for entry level through long term specialists that cover all aspects of the ITS program. ITS skills for FHWA technical specialists should be developed.
- Training Needs:** Development of an intensive post-graduate traffic operations/ management certificate program. Develop and offer new workshops, seminars, and short courses on narrowly focused ITS Technical topics. Task Force divided into five groups, each group identified training needs. The groups collectively identified 54 specific training needs. Some identified more than once. (See List)
- Other Issues:** Identify a number of methods to deliver training. Identify existing training providers. Identify need to identify and prioritize staff requiring training. Need to develop a strategy to show importance of ITS staff training to senior management and elected officials.
- Conclusion:** Listing of training needs and training approaches first step in setting priorities, identifying who needs training, and developing courses and curricula.

The following information is from the report summarized on the previous page. Five groups of FHWA staff were asked to identify ITS training needs. Each group reported training needs and the number of groups identifying the same need are provided below.

ITS Training Need Identified by:

<p>Five of Five Groups Operations & Maintenance Planning (Process for ITS)</p> <p>Four of Five Groups Communications Contracts and Procurement Marketing/Market Evaluation Overview Systems Architecture</p> <p>Three of Five Groups Awareness Computer Systems/ADP/Software/Hardware Construction/Inspection/Practices Funding/Financing Institutional Issues Legal Issues Standards Systems Engineering Traffic Modeling Software User Services</p> <p>Two of Five Groups Benefits/Costs Demand Management Strategies Design Features Evaluation Incident Management Partnering Research & Development Safety Specifications</p>	<p>Two of Five Groups (cont'd) Traffic Control Systems Traffic Flow Theory Train the Trainer/How to Train</p> <p>One of Five Groups Acceptance Inspection ATMS Control Center Operations Computer Selection Electronic Toll and Traffic Management (ETTM) Electrical Engineering Federal Aid Process Human Factors Information Dissemination Techniques International Issues ITS Overall/Integrated Training ITS Technical Issues ITS Technologies Navigation Needs Determination Operator Training Risk Management Security Signal Timing Successes & Benefits for Congressional Staff Systems Design Systems Integration Traffic Engineering Traveler Information User Acceptance</p>
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VII. Appendix C - Staffing and Training Needs Assessments

- Report/Paper:** I-95 Corridor Coalition *Project I I Training and Technology Exchange Final Report*, Prepared by I-95 Northeast Consultants, August, 1996.
- Method:** Synthesized information from other reports and studies.
Surveyed agencies involved in ITS deployment and providers of training to transportation professionals.
- Key Finding(s):** Identified the following six major functional areas where training will be required: Planning, Design, Construction/Installation, Operations, Maintenance, and Management.
Functional areas roughly conform with the deployment sequence.
Some training in ITS technologies identified.
- Training Needs:** Survey respondents identified extensive, moderate, or little or no training needs by each functional area. (See Table)
Training needs identified broadly by technologies, then narrowly within technologies. For example, communications is further narrowed to include wire, wireless, Information Exchange Network, and National Transportation Information Communications Protocol (NTCIP).
- Other Issues:** Survey also asked questions about agency training programs, types of training preferred (hands-on, computer tutorials, etc.), training providers, and training program conditions (days, location, cost). Provide some guidance when designing delivery approach. Identifies training programs.
- Conclusions:** Assessment of training needs of agencies involved in implementing ITS along the I-95 Corridor. Most extensive analysis done to date. Limited to needs of agencies along single corridor developing specific approaches to traffic management. Training courses and curricula are not evaluated for appropriateness to training needs, more analysis of these programs required.

I-95 Study, Summary Table (Previous Page)

Technology	Planning				Design				Construction				Operations				Maintenance				Management			
	E	M	L	NR	E	M	L	NR	E	M	L	NR	E	M	L	NR	E	M	L	NR	E	M	L	NR
ATMS																								
Traffic Control & Surveillance																								
- Probe Technologies		X				X				X				X	X			X				X	X	
- Sensor Technologies		X				X				X				X	X			X				X		
- CCTV		X				X				X				X				X				X		
- Freeway Control	X					X				X				X				X				X		
- Traffic Signal Control				X				X		X		X						X				X		X
- HOV Lane Control		X				X				X		X						X				X		
- Video Imaging Processing		X				X				X				X		X		X				X	X	
- Violation enforcement systems		X				X	X			X	X			X		X		X				X		
- Ramp metering			X				X			X	X							X				X		
- AVL/AVI		X					X			X	X							X				X		
Incident Management																								
- Incident detection & verification	X					X				X		X						X				X		
- Incident Response	X					X				X		X						X				X		
- System Optimal Routing	X					X				X		X						X				X		
Electronic Toll & Traffic Management																								
ATIS																								
- Broadcast-based		X				X	X	X			X	X						X				X		
- In-vehicle				X			X			X		X						X				X		
- Variable Message Signs (VMS)		X				X				X		X						X				X		
- Highway Advisory Radio (HAR)	X	X	X	X	X					X		X						X	X			X		
- Kiosks		X				X				X	X	X						X				X		
- Traveller advisory telephone		X				X				X		X						X	X			X		
- Route guidance	X	X		X	X					X		X						X				X		
APTS																								
- Transit vehicle tracking				X			X			X				X				X				X		
- Multi-modal coordination		X				X				X	X	X						X				X	X	
CVO																								
- Freight administration			X				X			X				X				X				X		
- Fleet administration			X				X			X				X				X				X		
- Electronic clearance				X	X	X	X	X			X	X	X					X				X		
- Weigh-in-motion	X					X	X			X	X			X				X				X		
- Roadside CVO safety				X	X					X				X				X				X		
- HAZMAT management		X				X				X	X	X						X	X			X	X	
Communications																								
- Wire	X					X				X				X				X				X		
- Wireless	X					X				X				X				X				X		
- IEN		X					X				X	X						X				X		
- NTCIP	X					X					X	X	X					X				X		
TMC	X						X				X			X				X				X		X
ITS Deployment Planning	X	X					X				X	X						X	X			X		
Institutional Issues	X	X					X				X	X						X	X	X		X		
Computer Systems																								
- Hardware		X				X				X				X				X				X	X	
- Software		X				X				X				X				X				X	X	

E = Extensive, M = Moderate, L = Low, NR = No Response
 X indicates the most common response or responses in surveys conducted as part of the I-95 Coalition Training and Technology Exchange Final Report.

- Report/Paper:** SAIC/JHK. *Technical Memorandum on ITS' Training Needs*, Presented to the Office of Traffic Management and ITS Applications, U.S. DOT, July, 1996.
- Method:** Reviewed studies done to date. Information from surveys used to develop a series of questions which were then used to gather information from 27 respondents. Respondents included six FHWA Region offices, six FHWA Division offices, four State DOT ITS contacts, four State DOT Training Coordinators, five transit agencies, and two MPOs.
- Key Finding(s):** Current levels of knowledge adequate to support current ITS activities. Current knowledge does not exist to enhance the ITS programs. On the job training and experience source of most knowledge of ITS. Identified specific training needs by same functional categories identified in I-95 Study.
- Training Needs:** Summary includes hardware/software operation and maintenance, quantifying benefits, integrating ITS into the planning process. (See Table)
- Other Issues:** Agencies are aware of several sources of training, including NHI, colleges, conferences/workshops, seminars, and vendors courses. Most favored means to accomplish training are seminars, short courses, in-house training, and videos. Lack of funds for travel and training and lack of time cited as obstacles to training. Most favored course length is 2/3 of a day. Other responses, which depended on training topic, were one day and 4/5 of a day.
- Conclusion:** Outlines information from various reports on ITS training needs. Initial attempt to synthesize training studies done to date.

Summary of Information from the SAIC/JHK Technical Memorandum (Previous Page):

	Functional Area					
	Planning	Design	Construction	Operations	Maintenance	Management
Training Area						
General Overview of ITS	X					
ITS Benefits	X					X
Integration of ITS into the planning process	X					
Technologies for different levels of personnel	X	X	X	X	X	X
Integrating ITS into facility design		X				
Plan reviews and specification development		X				
Procurement issues		X				
ITS costs		X				
Inspection procedures for ITS equipment			X			
Technician training				X		
Operations and maintenance costs					X	
Technical training				X		
Costs and staffing requirements					X	X
Managing ITS projects						X
Systems engineering						X

An X indicates a need for training in the specific functional area for the training area. For example, General Overview of ITS Training is needed in the Planning Functional Area. ITS Benefits training is needed for the Planning and Management Functional Areas.

> *Note that this study is not a needs assessment but a model for completing a needs assessment.*

- Report/Paper:** *Virginia Tech Virginia Tech Model for Professional Capacity Building: Comprehensive Needs Analysis & Functional Specialization, Undated.*
- Method:** Begin with 405 potential training areas for PCB. Next step is to determine who will be the beneficiaries of PCB efforts. For example, what skills are required for staff responsible for an Incident Management System?
- Key Finding(s):** Identify 405 potential training/education targets by considering three-dimensional matrix that includes 9 Functional areas, 9 ITS components, and 5 types of organizations requiring training.
- Training Needs:** Functional areas where training is required for ITS components are Planning, Funding/Policy, Design, Construction/Inspections, Operations, Maintenance, Major Investment Studies (MIS), Enforcement, and Public Relations.
ITS Components include Freeway Management Systems, Traffic Signal Systems, Incident Management System, Traveler Information System, Transit Management System, Electronic Toll Collection, Electronic Fare System, Railroad Grade Crossing, and Emergency Response Providers. Sectors requiring training are Federal Agencies, State Agencies, Local Agencies, Private Corporations, and Educational Institutions.
- Other Issues:** Need to determine what organizations will be responsible for deploying ITS in order to determine who needs what training. The next step is to determine the level and type of training they need. Once training needs are established, it is possible to analyze existing resources that may be used to develop training courses. The last step is to identify the specific knowledge staff and students involved in ITS require.
- Conclusion:** Defines approach to identify ITS training needs, developing curricular courses, and materials, and testing the effectiveness of materials.

VIII. Appendix D - Glossary of Acronyms

APTS	Advanced Public Transportation Systems
ATCS	Advanced Traffic Control Systems
ATIS	Advanced Traveler Information Systems
ATMS	Advanced Traffic Management Systems
AVI	Automatic Vehicle Identification
AVL	Automatic Vehicle Location
CCTV	Closed Circuit Television
CVO	Commercial Vehicle Operations
CAD	Computer Aided Dispatch
ETTM	Electronic Toll and Traffic Management
FATMS	Freeway Advanced Traffic Management Systems
FHWA	Federal Highway Administration
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
IEN	Information Exchange Network
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
IVHS	Intelligent Vehicle Highway Systems
MIS	Major Investment Studies
NHI	National Highway Institute
NTCIP	National Transportation Communications Information Protocol
NTI	National Transit Institute
TDM	Traffic Demand Management
TMC	Traffic Management Center
U.S. DOT	United States Department of Transportation
VMS	Variable Message Signs

**Intelligent Transportation Systems
Professional Capacity Building Program:**

**Section II —
Field Interviews**

Preface

The Needs Assessment Field Interviews were initiated to supplement the findings of previous studies. A companion report, “ITS Professional Capacity Building Needs: A Review and Synthesis of Thirteen Prior Studies” by the Volpe Center, describes studies sponsored by the Federal Highway Administration (FHWA) and others which reviewed ITS needs assessments and currently available courses that may be applicable to ITS, including formal degree programs, in-service workshops, on-the-job training, and self-directed training.

Preliminary Findings

Through a series of interviews with ITS field practitioners, this study found that professionals have a broad, conceptual idea of what ITS training and education is needed. This study also identified the desire to have U.S. DOT develop and deliver courses in three main areas. In general, Federal, State and local respondents agreed on training needs, although some Federal Transit staff suggested they need more ITS training than Federal Highway staff.

Training Needed:

Technical:

- Communications hardware technology: fiber and wireless, switches, routers and video equipment
- System engineering and architecture for public agencies
- Traffic management software, data and analysis
- Maintaining systems after warranties expire

Institutional:

- Interacting with other agencies
- “What’s in it for me” -- ITS Advocacy training:
 - How to get staff to use ITS technology?
 - How to get stakeholders to buy into ITS?

Contractual:

- Writing specifications
- Understanding the software development process
- Managing contract workers

Preliminary Conclusions

Lack of training may be impeding deployment, but courses offered through the ITS PCB program will help implement deployment. Other training could be added to fill in gaps as identified in this study.

I. Purpose and Scope

I.A Purpose of the study

Intelligent Transportation Systems (ITS) are designed to enhance the safety and efficiency of surface transportation systems by implementing advanced electronics, sensors, navigation devices, communications, and information technologies. The ITS Professional Capacity Building Program (PCB) was established to ensure that current transportation professionals have the knowledge, skills, and abilities to effectively deploy ITS.

This study was designed to identify the skills required for current professionals to implement successful ITS deployments over the next five years. The objectives of this study were to identify skills gaps which impede ITS deployment, and to identify training courses that could facilitate ITS deployment.

I.B Scope of the study

This study, built on prior studies previously discussed, focused on the installation and operations stages of ITS deployment, and on the critical training needs at all job-related functional levels. It included an on-site visit to Atlanta to conduct personal interviews with employees of the Regional offices of the Federal Transit Administration and the Federal Highway Administration, managers and staff of the Atlanta City DOT, the Georgia Department of Transportation, and the Metropolitan Atlanta Rapid Transit Authority (MARTA). A questionnaire was developed and piloted for the Atlanta interviews (see Appendix A). After the on-site visit, the questionnaire was revised and abbreviated for use in telephone interviews with federal and local government staff in selected cities around the country (see Appendix B). Interview locations were selected based on their levels of ITS deployment.

I.C Context

The Field Interviews study was initiated to supplement the findings of previous studies. A companion report to this study, “Intelligent Transportation Systems Professional Capacity Building Needs: A Review and Synthesis of Thirteen Studies” by the Volpe Center, describes and synthesizes prior studies sponsored by other organizations, including FHWA. This synthesis recommends that more work be done “to identify which types of training are most appropriate for specific skills, and how types of training should be incorporated in the deployment process.”

This report begins to address that recommendation.

II. Interview sites and subjects

Interview sites Interviews have been conducted with transportation professionals in locations with various levels of ITS deployment:

<i>Low level of deployment</i>	<i>Medium level of deployment</i>	<i>High level of deployment</i>
St. Louis/Kansas City	Louisville	Atlanta
Salt Lake City	Boston	Houston
	Tucson	Minneapolis
	Denver	

On-site interview subjects

On-site interviews were conducted in Atlanta, which deployed ITS technology for use during the 1996 Summer Olympics. The subjects' areas of expertise ranged widely: from the state transportation Commissioner, to a transit systems analyst, to an ITS operations engineer. The subjects interviewed included:

- . FTA regional administrator and ITS specialists
- . FHWA regional administrator and ITS specialists
- . Georgia Commissioner of Transportation
- . State Traffic Management Center traffic engineers
- . City of Atlanta Traffic Systems Manager
- . MARTA vice presidents, systems analyst, ITS engineer/consultant
- . An ITS America staff person who held a position with MARTA during the Olympics

Telephone Interview subjects

Telephone interviews were conducted with these transportation professionals:

- . Regional FHWA ITS specialists in Kansas City, Salt Lake City, Denver, Boston
- . Tucson city traffic engineer
- . Regional FTA ITS specialists in Tucson
- . Houston Metro engineer
- . Kentucky DOT project manager
- . Minneapolis Traffic Management Center Manager
- . Utah DOT Traffic Management Engineer
- . Tucson ITS Program Coordinator

Continued on next page

Interview sites and subjects, Continued

Training categories in this report

For purposes of categorizing the training mentioned by interview subjects, training in this report is divided into three areas: technical, institutional and contractual.

- . Technical refers to courses about the particulars, details and methodologies of an ITS technology.
- . Institutional refers to courses about the impact of ITS on the organization(s) adopting the new technology.
- . Contractual refers to courses about working with vendors of ITS technologies and federal funding issues.

III. Technical training desired

- Technical training** Many respondents described a need for technical training. The following were the most commonly mentioned areas (defined as mentioned by 19% or more of respondents):
- . Communications hardware technology: fiber and wireless, switches, routers and video equipment (50%)
 - . Database (relational and spatial) querying for traffic management operators (37%)
 - . System engineering standards and architecture for public agencies (37%)
 - . Software used in ATMS systems (37%)
 - . Maintaining systems after the warranties expire (23%)
 - . Understanding the software development process (27%)
 - . TMCC hands on training (23%)
 - . Use of AVL and APC equipment for transit operators (20%)

Technical areas Most respondents said that highly technical training is often provided either by the vendor of the technical equipment or in a university setting. However, many also stated that their operators and administrators needed a one to two day training course in technical issues, sufficient to provide working knowledge of system capabilities adequate for management and oversight purposes.

Software came up often when discussing technical training needed. “We need to get management training on what standards apply, what could you use, how do you spec out the requirements, how do you track and monitor development, what kind of inspections are needed, what kind of skills do you need-not to make someone a programmer, but enough to talk to programmers, to help them understand programmers.”

“Training for maintenance of ITS is needed; it’s easy to write and procure systems but if you can’t operate and maintain them, they’re not that good.”

IV. Institutional training desired

Institutional training

Suggested institutional topics include:

- Analysis of ATMS traffic data as it pertains to local traffic management (43%)
- Working with your counterpart at another agency (40%)
- “What’s in it for me” training: how to get staff to use ITS equipment (27%)
- Crossing jurisdictional boundaries in incident management (23%)
- Working with incident response partners (20%)

Institutional areas

A continuing theme among interviewees was the suggestion that ITS operators need a better understanding of forthcoming changes within the organization as a result of adopting ITS technologies. Several said they wished they had been warned about the impact of ITS on their business processes, and suggested that a workshop describing these issues would be a way to prepare for working with ITS.

Getting departments to talk to each other, to know what to expect was mentioned by several interview subjects. “Operations people need to learn from the technical people — what can you expect from the system, what is the confidence level? Technical people need to know what benefits the system is expected to provide.”

A city traffic manager echoed this view; “We need people who can develop, manage, and strategically plan the evolution, who can develop response plans that span more than one problem. They need to understand advanced concepts of operation and the many paths of incident management.”

One state ITS planner proposed, “It would be good to bring people together for emergency management workshops.”

A city engineer with an ITS staff mentioned his need for training in cost recovery--is it worth the investment? “It would be helpful to have case studies of ITS success stories and disasters in the United States and internationally,” he said. He also wants a list of commercial products available.

Continued on next page

Institutional Training Desired, Continued

Institutional areas, cont'd

Another respondent said that transportation staff members need very little technical ITS training, but considerable training in how to sell benefits of ITS to the public. How to deal with public policy officials: city councilmen, etc. Don't [train] on technology; it's really an issue of deployment and marketing."

Another added the need to go beyond how to operate a traffic camera and train people in the related legal issues. "Liability issues, give [students] a list, plus a discussion--four hours, tops," he said. And include "privacy issues for surveillance cameras."

V. Contractual training desired

Contractual training

Contractual areas include:

- Writing specifications (57%)
- Understanding the software development process (30%)
- Managing contract workers (30%)
- Maintaining systems after the warranties expire (27%)

Contractual areas

One of the frustrations expressed by those who had “been through” the Olympics was that they didn’t know enough to talk knowledgeably with the vendors and contractors about development plans. In hindsight, they recognized that training might have helped them understand what contractors were doing, where contractor responsibilities ended, how to create meaningful specifications, and how to oversee the contractor in the delivery of specified services.

“ITS is too big, you can’t just go out and ‘buy one’,” said one subject. “You have to break it into pieces and then understand what the role of each piece is. I struggled a lot in how each individual contract related to the whole — we had 80 contracts, some for construction, some for services. Such contracts are different creatures in the federal world. There are different processes to get the contracts. It took forever for me to understand how contractors related to each other. Then another big hurdle was to understand what key elements each contractor had to accomplish to work together.”

How to conform to Federal aid requirements was another subject mentioned by some of those interviewed, “Questions arise--what can standard Federal Aid funds be applied to, contracts, funds, etc., what are the procurement [strategies] that have worked elsewhere. Federal aid and Federal ITS program funds are not separate, but they are different.”

Start with the basics, said one transportation expert, “Start with generic — architecture, transportation planning process. Put ITS on that timeline. Take [U.S.] through the process: elements, costs, benefits, operations, and maintenance.”

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Contractual training desired, Continued

Reading and writing specifications

Several people mentioned a need for reading and writing specifications. “We don’t have the ability to read specifications for accuracy,” said one interview subject.

Another said, “a lot of hardware and software is proprietary; however writing specs for an architecture or a system could be taught. Training on the national ITS architecture will be critical, especially if the next legislation says ITS systems that are deployed must be in conformance with the national architecture.”

“ITS people are often civil engineers, dealing with systems, software, communications, and dealing with people who don’t know our area. It’s hard to talk with other organizations and with their people, so training is needed on project management. Inside a state DOT, ITS is not being handled by people who’ve been handling contracts, who know about keeping diaries and who have different responsibilities, who know how to talk to contractors. State DOT staff need to be trained in negotiation skills, responsibility, scheduling, Gantt charts, how to direct the systems manager.”

A transit manager was very explicit on this point. “It’s a question of civil engineering vs. systems engineering mentality. Yes, there is a technology gap but the methodologies are also very different. Generally the [traditional] system is that planners give plans to civil engineers who then write up preliminary engineering reports which focus on general design. Later a final design report with specifications is done. This plan is then passed on to a construction firm. Each stage of the process is distinct. In systems engineering, this process is entirely different since its methodology is based on software. This is much more appropriate to ITS.”

VI. Results

Results Despite their differing methods and audiences, both types of interviews led to similar conclusions, that the U.S. DOT should provide training in three main areas: technical, institutional, and contractual.

The Georgia DOT commissioner emphatically described the need for training. “We’re operating in an environment with dramatically new tools — if you don’t train people **to** use them, you’re just throwing the money away. You can’t build a system and bring in the most dedicated people, if you haven’t trained the locals in what to do after the construction crew has departed.”

Federal vs. state and local results

Generally percentages for federal (FHWA and FTA) and non-federal (state and local) interview subjects were similar. The biggest differences were in the areas of:

- software development (a surprising 36% for federal vs. 19% for state and local)
- network maintenance (57% for federal vs. 31% for state and local)
- writing specifications (71% for federal vs. 44% for state and local)
- ATMS traffic data analysis (57% for federal vs. 31% for state and local)
- the “what’s in it for me” category (36% for federal vs. state and local)

Comments on network maintenance came from an FHWA ITS engineer who felt that “the most important thing is to know how to operate it and maintain the system, so staff should be well trained.” A non-federal traffic systems manager felt that staff should have a background in traffic engineering and systems maintenance but felt they could not afford to hire these people.

The software development process was training that federal respondents felt they needed for themselves, as well as for the transportation people at state and local agencies. The local people did not report this need. As to “what’s in it for me,” federal people felt that local staff need more training in how to convince others — either the taxpayers, or the operators and practitioners — that new ITS technologies would be beneficial.

Continued on next page

Results, Continued

Federal vs. state and local results, cont'd

Writing specifications for a system or architecture was of high importance among all respondents. A federal transportation planner said, “writing specs will become critical if the next legislation says ITS systems that are deployed must be in conformance with the national architecture.” This need was also recognized by nearly half of the respondents working at the state and local levels.

A regional federal transit coordinator pointed out the need to train people in the big picture. “The key is to understand cross-modal applications of ITS — the link of highway and transit operations. ITS is only a mechanism to bridge the highway/transit divide. ITS offers to eliminate redundancies. It’s also a tool to link MPOs — each transit system is a fiefdom — they don’t want to talk to each other.”

Federal Transit

Not surprisingly, transit staff tended to say they got less attention than highway staff. They said they need even more training in ITS at this point in its development than some highway staff: “FTA people may need more details than FHWA because FHWA is more into ITS....Transit systems are just as [uninformed] as we are.”

“Current ITS seminars focus on highway applications. It would be more useful to see strictly transit programs and/or cooperative projects that FHWA and FTA have done,” said another transit specialist.

VII. Other observations

Impediments and challenges Several respondents were discouraged by their own department's lack of training funds, reluctance to purchase training, or send staff to training, some states limit out-of-state travel, and other organizations are simply not funding travel or time away from the job.

“University training wouldn't hurt but it's tough to do because everything [develops] so fast and there's no time for anyone to get trained at that level,” said one engineer.

One interview subject expressed a need for recurring training by pointing out the difference between road building and ITS systems. “[ITS] hardware will be obsolete in three years,” he said. “Our systems used to be stable for ten years. If you build a highway, you could walk away and it would have value ten years later. ITS doesn't work that way — it has no residual effect.”

Continued on next page

Other observations, Continued

Media

Determining appropriate training media was not a specific area covered in interviews but several subjects volunteered their opinions, focusing mostly on their lack of time and lack of travel funds, thereby indicating a need for locally available training — either via video, distance learning, computer-based interactive training, or some other medium that would keep them on the job as much as possible.

A MARTA consultant recommends a training video for the operator lounge so that transit and bus operators can informally learn about enunciators.

Several respondents want to see how their counterparts in other states or cities deal with new technology, a particular problem for government employees who have no funding for out of state travel. One federal respondent said that videotaping ITS users and distributing the videos to other procurement sites would be effective.

A state traffic engineer said, “I’d like to know more about how traffic management centers operate, but when the FHWA offers executive tours, they want the [state traffic] commissioner to go. I don’t get to go.”

Another engineer noted a need for “simulated traffic operations centers, or short term training gained by spending time working in another operations center.”

In Houston, according to the Metro’s director of planning and development, the FHWA through a Florida vendor, made training slides available to local agencies. “This is great,” he said, “because they can be used by in-house trainers to do workshops.”

Continued on next page

Other observations, Continued

University and technical programs

In many cases, respondents expressed an interest in taking university level courses, if they were available at technical colleges. Several suggested that engineers should be required to take courses in specification writing, as well as in human relations areas, e.g. working with contractors and other agencies.

Respondents also felt that in-depth technical courses, such as wireless and fiber optics communications, should be offered at the university level, with the caution that such courses may become quickly obsolete, or might be too theoretical to be of maximum value for ITS technicians.

Vendor training

According to several respondents, technical training in the use of proprietary, unique or highly specialized vendor equipment is usually included in the equipment or vendor services contract. Because of the nature of the training, the vendor should continue to supply the primary training; supplementary training could be provided by DOT.

Continued on next page

Other observations, Continued

On-the-job training

On-the-job training (OJT) is often the most realistic method for mastering the operation of specialized equipment or the application of theoretical training to a specific metropolitan area. At very high levels, OJT is the only method cited for motivating directors and managers of complex traffic control centers or other organizations using ITS equipment to perform vital and complicated tasks. Good management is the result of years of experience.

One federal ITS specialist emphasized hands-on training. “Lectures on ITS programs are fine for general information but hands-on training is needed to really understand the systems,” he pointed out, “The level of technological know-how varies according to participants; therefore, one-on-one learning plans are important to build up individual technological expertise. Mentoring could be useful here.”

In addition, internship at ITS sites in another city was recommended as a method of providing hands-on training in real life settings. Some respondents would like to extend the level of those invited to such events beyond the state commissioner level.

Another respondent said, “Scanning tours of Atlanta and Houston are fine to see the extent ITS can be implemented; however, those cities have [large] budgets to do ITS. it would be nice to have site visits in cities which have comparable budgets and transportation issues, for example, Minneapolis as a model for Kansas City.”

VIII. Conclusions and Next Steps

Training development

This report lists eight technical, five institutional, and four contractual topics as an ITS training needs. Each was mentioned by 19% or more of participants. It will be important to verify the priority of these needs, and to compare the recommendations to the courses already under development. Based on these priorities, training developers could begin the formal course design process and identify subject matter experts whose input will be needed to guarantee completeness and accuracy. A review team would be established for each course to analyze and critique course content, education design, and the relevancy of the materials to field practitioners.

Continuing needs analysis/assessment of priorities

Although the study results are consistent, additional research is needed to further define training needs. With more input from those “in the trenches”, course planning could be refined and the most urgently needed courses could be developed expeditiously.

IX. Requests for Training

Communications hardware training	<p>Content: Technology: fiber and wireless, switches, routers and video equipment</p> <p>Audience: Executive, management</p> <p>Deployment stage: Planning, designing, implementation, operations, maintenance</p>
Database querying	<p>Content: Relational databases, spatial databases, querying, traffic management processes</p> <p>Audience: Management, practitioners, technicians</p> <p>Deployment stage: Operations, maintenance</p>
Specifications training	<p>Content: Reading; writing, understanding, monitoring specifications</p> <p>Audience: Management</p> <p>Deployment stage: Planning, designing, implementation</p>
Traffic management training	<p>Content: Software, traffic data and databases, and traffic management analysis</p> <p>Audience: Management, practitioners, technicians</p> <p>Deployment stage: Operations, maintenance</p>
Systems engineering training	<p>Content: Systems engineering and architecture for public agencies, integration, contract limitations, planning for growth</p> <p>Audience: Executive, management</p> <p>Deployment stage: Planning, designing, implementation</p>
Interagency training	<p>Content: Interacting with other agencies, other government levels and incident response teams and organizations</p> <p>Audience: Executive, management, practitioners, technicians</p> <p>Deployment stage: Planning, designing, implementation, operations</p>

Continued on next page

Requests for Training, Continued

<p>Software development training</p>	<p>Content: Understanding the software development process Audience: Executive, management Deployment stage: Planning, designing, implementation</p>
<p>Managing contract workers</p>	<p>Content: Contract boundaries, areas of responsibilities Audience: Executive, management, practitioners Deployment stage: Implementation, operations, maintenance</p>
<p>“What’s in it for me” training</p>	<p>Content: How to sell the ITS benefits to decision makers, taxpayers, stakeholders, and operators Audience: Executive, management Deployment stage: Planning, operations, maintenance</p>
<p>Maintaining computer networks</p>	<p>Content: What to do after the warranties expire Audience: Management, practitioners, technicians Deployment stage: Operations. maintenance</p>

X. Responses by deployment level

High deployment sites

Although Atlanta and Salt Lake City are both identified as high ITS deployment sites, those interviewed said they are still learning about how to operate and maintain the new systems. A concern from Atlanta respondents was how to operate **and** maintain their systems after the vendors leave and the service contracts expire.

Medium level deployment sites

Respondents in areas considered to have a medium level of deployment are concentrating on designing and procuring networks to support variable message signs, CCTV camera feeds, and traffic management centers. Perhaps because network development is the most visible and complex component of early ITS deployment, transportation professionals are eager to get training on procuring these emerging technologies, and on how to maintain and operate them once they've been delivered. One respondent at a state DOT in a "medium" deployment site said the if her department "had the in-house expertise, we could better guide the consultants, instead of relying so heavily on them." She would like to see how traffic management centers operate in other states, that she was lacking even such a basic level of training.

Low level deployment sites

Those at low-level deployment sites are still requesting the basics of ITS awareness and training such as telecommunications, ITS deployment, etc. Many of them want just enough training to be able to discuss implementation with vendors, create contracts and RFPs, write practical specifications, and oversee the vendor activities during the bidding and deployment phases.

XI. Appendix A: On-site Interview Guide

This interview outline is based on a format from Rossett (1987) which was designed to provide an “agenda” for each interview, while insuring that the questions remain spontaneous and open ended. (For the interviews themselves, this was redesigned into a three-column format, with the last column providing a place for note taking.)

Purpose	Prompt
About the project	<ul style="list-style-type: none"> • is one of nine cities chosen for being a national leader in ITS • Study goal: to learn about training needs for other sites based on your experience
About me	<ul style="list-style-type: none"> • Volpe Center background • personal background
About this meeting	<ul style="list-style-type: none"> • your opinions on training needed • your suggestions for others we should talk to • should take 45 minutes or less • will send you “Quick Notes” summarizing the interview for your review
About the study	<ul style="list-style-type: none"> • purpose is to identify what training is needed, based on lessons learned at leading ITS sites • we will be focusing on three key stages of ITS deployment: Implementation, Operations, and Maintenance
About you	<ul style="list-style-type: none"> • job title • background • Metropolitan elements <ul style="list-style-type: none"> • Smart Traffic Signal Control • Freeway Management • Transit Management • Incident Management • Electronic Toll Collection • Electronic Fare Payment • At-Grade Railroad Crossings • Emergency Response • Regional Multimodal Traveler Information Systems • about how long have you been involved in metropolitan deployment?

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Appendix A: On-site Interview, Continued

<p>Big picture</p>	<ul style="list-style-type: none"> • what is the “big picture” of all the broad job categories, people, and agencies needed for a successful ITS deployment? • what do you “wish you knew” about ITS training before you started? • what are the highest priority training needs for implementation? • what are the highest priority training needs for operations? • what are the highest priority training needs for maintenance? • what do you see as future training needs? • in your opinion, to what extent were training needs met in your area?
<p>Implementation stage</p>	<p>Is additional training needed in:</p> <ul style="list-style-type: none"> • contract management • configuration management/ documentation • testing • personnel training • other _____
<p>Operations stage</p>	<p>Is additional training needed in:</p> <ul style="list-style-type: none"> • evaluating operations • interagency operational issues • costs (by component) • other _____
<p>Maintenance stage</p>	<p>A study by Apogee research singled out the following areas for this stage. Is additional training needed in:</p> <ul style="list-style-type: none"> • Maintenance issues/ options • Interagency operational issues • Costs (by component) • Other _____

Continued on next page

Appendix A: On-site Interview, Continued

Job categories	<ul style="list-style-type: none"> • which of the following job categories would you like to discuss training needs for <ul style="list-style-type: none"> • executive • management • practitioners • technicians • describe the organization, including positions and number of people in each • for each position, list: <ul style="list-style-type: none"> • what KSAs are required for the position? • where did the practitioner obtain his/her KSAs? • any other KSAs required, but currently lacking? • which KSAs are most critical and immediate? • what changes need/ needed to occur to make the position effective in supporting ITS deployment? • what future training might be anticipated?
Feelings	<ul style="list-style-type: none"> • are most workers confident that they have the KSAs they need? • did people feel that the training was effective? • did people feel that they got enough training? • what worked best in training? • what training approaches did not work well? • what would be the best way to get “buy-in” and acceptance of future training?
Critical incidents	<ul style="list-style-type: none"> • what was the most effective thing you did to train people? • what was the biggest training problem you faced? • what was the biggest obstacle to deployment? • how could it have been helped by training?
Wrap-up/summary	<ul style="list-style-type: none"> • any special conditions in your metropolitan area which make it inappropriate to generalize your conclusions? • any other items regarding training you wish to discuss? • do you want to elaborate on anything previously discussed?

XII. Appendix B: Telephone Interview questionnaire

DATE _____

NAME AND AGENCIES OF PERSON(S) INTERVIEWED

LEAD INTERVIEWER

Part 1: Background (5 minutes max)

About the project

1. We are studying nine cities, including yours, which are national leaders in ITS
2. Study goal: to learn about training needs for ITS Implementation, Operations, and Maintenance
3. There are other studies going on looking at needs for other stages of deployment, e.g. how do you get funding
4. This study is focused on what is needed in the trenches by technicians and practitioners (not management) when they actually implement and operate systems
5. Volpe Center background
6. personal background

About this call

7. we want your opinions on training needed
8. we also want your suggestions for others we should talk to
9. it should take 45 minutes or less
10. we will send you “Quick Notes” summarizing the interview for your review

Part 2: 7 key questions

Instructions: Check off each as it is answered; do not go to Part 3 until these have been completed.

Question 1: What is your job? What are the jobs of your staff?

Question 2: What other jobs in the ITS area are closely related? How many people are there, what other agencies do they work for, and what do they do?

Continued on next page

Appendix B: Telephone interview questionnaire, continued

Question 3: If you left this job due to a promotion, and had to train your replacement to work with ITS equipment or technologies, exactly what would you need to teach them to do? OR if a staff member left this job due to a promotion, and you had to train their replacement to work with ITS equipment or technologies, exactly what would you need to teach them to do?

Question 4: If you stay in this job for several years, is there any training that would make you more efficient OR if your staff members are likely to stay in their jobs, is there any training that would make them more efficient?

Question 5: If you were hired as a consultant to a city that was just starting out to install ITS systems, what training would you recommend they offer to new staff?

Question 6: If your manager asked you to write a report summarizing how to use these systems more effectively, what would you recommend?

Question 7: Do you have any other advice on future training for yourself, for others like you, or for your staff?

1.5":::

**Intelligent Transportation Systems
Professional Capacity Building Program:**

**Section III —
A Summary Assessment of ITS Training and
Education Needs**

Preface

The Summary Assessment of ITS Training and Education Needs was developed using the results of *Section I — A Review and Synthesis of Thirteen Prior Studies* and *Section N — Field Interviews*. The first two sections identified what is currently known about ITS training and education needs. They also identified gaps in knowledge, skills, and abilities (KSAs) needed to deploy ITS components nationwide.

The following presentation in *Section III — A Summary Assessment of ITS Training and Education Needs* — presents the findings from sections I and II in summary form. It presents the state-of-the-knowledge about ITS training and education needs from two perspectives. The first categorizes the findings by ITS application area — ATMS, ATIS, APTS, etc. The second perspective groups the findings by deployment stage — general awareness, planning, design, **procurement, installation, and operations**, and **management** — in order to highlight the more immediate and critical needs that support deployment.

As noted in the Executive Summary of this report, the next step for the PCB program will be to take these findings and develop a more comprehensive understanding of the full range of ITS training and education needs. An upcoming, more formal assessment is planned that will gather data on training and education needed:

- at each deployment stage,
- for each agency involved in ITS deployment, and
- for each level of staff within agencies.

Staff levels include executive decisionmakers, management, operational practitioners, and technicians; ITS deployment will impact and/or involve each of these levels. By gathering data relevant to these categories, the next needs assessment will fulfill the objectives of providing detailed information for course development and providing information that allows professionals to understand what training directly supports their more specific ITS deployment activities.

The Summary Assessment concludes with a list of near-term priorities to emphasize:

- the importance and relevancy of ITS,
- planning for regional integration, and
- the need to address institutional, technical and operations and management issues.

Prior Studies

- ***Workforce Studies***
 - 1993 Urban Institute, *IVHS Staffing and Education Needs*
 - 1994 Carlton Robinson, *Traffic Operations Manpower*
 - 1994 FHWA, *ITS Field Technical Expertise Workshop*
 - 1996 ITE, *Operating and Maintaining ATMS Centers (Conf)*
 - 1996 ITE, *Operating and Maintaining ATMS Centers (Papers)*
- ***Training Studies***
 - 1995 DOT, *ITS Professional Capacity Building Assessment*
 - 1995 ITSA / DOT, *ITS Education and Training Workshop*
 - 1995 ITSA / DOT, *Strategic Plan for Education and Training*
 - 1996 Calif. Adv. Trans. Training Alliance, *The View Ahead*
 - ITE, *Urban Traffic Engineering Education and Training Needs*
- ***Workforce and Training Studies***
 - 1996 I-95 Corridor Coalition, *Training and Technology Exchange*
 - 1996 SAIC/JHK, *Technical Memorandum on ITS Training Needs*
 - Virginia Tech, *Virginia Tech Model for PCB (Methodology)*

Prior Studies: Overall Summary

- *Full agreement that training is necessary to build staff needed for full ITS deployment*
- *Highway traffic professionals major source of information; limited transit perspective*
- *Skills, training needs, training sources, and training and staffing issues identified in general*
- *Insufficient treatment of specific learning objectives and/or priorities*

ATMS

- *Addressed in majority of prior studies*
- *High level of interest in incident response and technologies*
- *Staffing and training concerns all aspects of deployment*
- *Most completely analyzed ITS component*

ATIS

- *Addressed in many prior studies*
- *High level of interest in route guidance and Variable Message Signs (VMS)*
- *Staffing and training concerns all aspects of deployment*

APTS

- *Addressed in only one study*
- *Highest APTS interest is in multi-modal coordination*
- *Information limited, studies collected little information from the transit industry*
- *Not clear that entire range of skills and needs have been identified*

CVO

- *Addressed in several studies*
- *Highest interest in*
 - electronic clearance
 - HAZMAT management
 - weigh-in-motion
- *Staffing and training concerns all aspects of deployment*

Design and Construction

- *Addressed in several studies*
- *High interest in systems architecture*
- *Limited information available to assess specific needs in deployment*

Enabling Technologies

- *Addressed in most studies*
- *High interest in all facets of computers and communications*
- *Technologies often identified without any application context*
- *Distribution of needs across deployment functions unclear*

Institutional Issues

- *Wide range of topics addressed in most studies*
- *High interest in understanding ITS benefits, institutional roles /partnering, and legal issues*
- *Unclear distribution of needs across deployment functions*

Operations and Management

- *Addressed in most studies*
- *High interest in all facets of operations and maintenance*
- *Few staffing and training needs linked to deployment functions*

Planning

- *Addressed in several studies*
- *Highest interest in*
 - ITS in the planning process
 - deployment/procurement planning
- *Few needs linked to deployment functions*

Field Assessment Study

- *Builds on*
 - 13 prior ITS staffing and training needs studies
 - Previous Volpe Center institutional research findings
- *Incorporates feedback from PCB courses*
- *Coordinated with and supplemented by*
 - FHWA Central Training Assessment
 - PCB Stakeholder White Papers
- *Initial Study done to explore field interests and needs*

PCB Field Needs Analysis Scope

- *Metropolitan ITS Infrastructure*
- *Deployment and Operations focus*
- *High, medium and low deployment sites*
- *FHWA / FTA and state /local staff needs*
- *Management through staff level needs*

Field Interview Sites

Deployment Level

Low

- . Kansas City
- . Salt Lake City

Medium

- . Louisville
- . Boston
- . Tucson
- . Denver

High

- . Atlanta
- . Detroit
- . Houston
- . Minneapolis

Response by deployment level

<i>High</i>	<ul style="list-style-type: none">• <i>Respondents are still learning</i>• <i>What to do when vendors leave</i>
<i>Medium</i>	<ul style="list-style-type: none">• <i>Strong design and procurement interests</i>• <i>Training in procurement and network development</i>
<i>Low</i>	<ul style="list-style-type: none">• <i>Need the basics, "What's in it for me?"</i>• <i>Awareness training and how to "partner"</i>

Field Site Interviewees

- *Regional FTA and FHWA staff and FHWA division staff (~ 50%)*
- *State and city traffic organizations (~ 20%)*
- *Regional transit agencies (~ 30%)*

Federal vs. State/ Local Responses

- *In general, close correlation between Federal and State / local responses*
- *However, more federal respondents than local emphasized:*
 - Software development process (36% to 17%)
 - “What’s in it for me” (36% to 17%)

Transit Input

- *Roughly 30% “transit” interviewees; emphasized:*
 - Training has focused on highway applications
 - FHWA has more ITS experience
 - FTA staff desire for more training
- *FTA and transit staff want:*
 - Context; understanding of their role
 - Understanding of the range of ITS options available

Specific Field Study Findings

- *Training needs spectrum includes:*
 - *Technical needs*
 - *Institutional needs*
 - *Procurement-related needs*

Technical Course Interests

- ***Communications hardware technology (46%)***
- ***Database querying for traffic management operators (38%)***
- ***System engineering and architecture (35%)***
- ***Software used in ATMS systems (31%)***
- ***Maintaining computer networks after warranties expire (23%)***
- ***The use of AVL and APC equipment for transit operators (23%)***
- ***Understanding the software development process (23%)***

Institutional Course Interests

- ***Analysis of ATMS traffic data (46%)***
- ***Working with counterparts at other agencies (35%)***
- ***“What’s in it for me”: how to get staff to use ITS equipment (27%)***
- ***Crossing jurisdictional boundaries in incident management (23%)***
- ***Working with incident response partners (23%)***
- ***Use of AVL / APC equipment for transit operators (19%)***

Procurement-related Interests

- ***Writing specifications (62%)***
- ***Understanding the software development process (31%)***
- ***Monitoring contractor staff (27%)***
- ***Maintaining computer networks after the warranties expire (27%)***
- ***Understanding Federal funding requirements (19%)***
- ***Other: - Creating specifications***
 - Assessing development plans
 - Tracking deliverables
 - Overseeing contractors
 - Where contractor responsibilities end

Impediments and Challenges

- *Limited funding for student travel*
- *Limited time to attend long courses*
- *Rapid turnover of trained personnel*

PCB Training Approach / Media

- *Need for local training*
 - video
 - distance learning
 - computer-based interactive training
- *Need for on-the-job training (especially managers)*
 - Hands-on
 - Mentoring
 - Internships
 - Scanning tours

Near-term Training Priorities

- **Awareness: *Importance and Relevancy of ITS***
- **Planning: *Needs Assessment and Regional Integration***
- **Institutional: *Procurement, Inter-agency relations, and Public /Private Partnership***
- **Technical: *Architecture, Telecommunications, Standards, Specifications, Contract Management***
- **O&M: *Configuration Management, Maintenance***